ASEE SOUTHEASTERN SECTION
ANNUAL CONFERENCE

APRIL 18 - 20, 2010

“The Engineering Educator of 2016”

Virginia Tech
Blacksburg, Virginia

Proceedings Editor: Barbara Bernal
Southern Polytechnic State University

Technical Program Chair: Zhaoxian Zhou
The University of Southern Mississippi

Site Chair and Coordinator: Tom Walker
Virginia Polytechnic Institute and State University
Contents

CHAPTER 1 CONFERENCE INFORMATION ................................................................. 0

Conference Welcome: Keith Plemmons, ASEE SE Section President 2
Monday, April 19, 2010 4
Tuesday, April 20, 2010 5
Conference Overview 6
Technical Sessions 7
   Monday, April 19, 2010 Technical Sessions 1, 2, & 3
   Tuesday, April 20, 2010 Technical Sessions 4, & 5
Technical Session Information 14
   Session and Presentation Timing
   Instructions for Technical Session Moderator Chairs
Student Poster Session Information 15
   Student Poster Competition Abstracts
   Poster Specifications
SKELETON CONFERENCE CENTER LAYOUT 16
Conference Workshops 17
Keynote Speaker 18
Keynote Abstract 19
Conference Sponsors 20
ASEE Southeastern Section Officers 21
ASEE SE 2010 Conference Registrants 22

CHAPTER 2 EXTENDED ABSTRACTS ........................................................................... 0

Improving Statics Instruction in Four-year Technology Programs 1
   Dr. George Ford, P.E., Dr. John Patterson, Mr. Ronald Bumgarner

A Student Survey of a Web-based Distance Learning Engineering Course 2
   Scott Schultz

Give them what they want: A look at student directed curriculum revision in a summer bridge camp 3
   Leigh McCue, Tremayne Waller, Erin Crede, and Jonathan Gaines

A Pre-Engineering Class to Help Transition Students Into an Engineering Major 4
   Donna S. Reese, Robert Green, Missie Smith

Development of Digital Audiovisual Lectures for an Engineering Course: A YouTube Experience 5
Synergistic Learning & Inquiry through Characterizing the Environment for Sustainability (SLICES): Improving Understanding of Real World Systems through Observation & Reflection

Annie R. Pearce, Christine M. Fiori, Kathleen M. Short, and Vera Novak

Undergraduate Civil Engineering Sustainability Education Metric (UCESEM): Benchmarking Civil Engineering Program Performance

Kathryn Augsburger and Annie R. Pearce

Introducing Undergraduates to Load Calculations: A Course Designed Around ASCE-7

Lori Koch, Richard Goff, and Janis Terpenny

Interviews with Experts, in which they Explain how they Solved Structural Failure Investigations

Luis A. Godoy

Directions for Engineering and Technology Educators to Improve Program Enrollments

Dr. George Ford, P.E., Dr. William McDaniel, Mr. Paul Yanik

Demographics and Diversity of Mercer University’s Graduate Engineering Programs

Richard O. Mines, Jr. and Greg Lofton

Using a rubric-based assessment system to improve feedback and student performance in course-management systems

Bob Edmison and Stephen H. Edwards

The Business of Engineering: Sharing Lessons on Motivating Potential Future Engineers

Otsebele Nare, Ziette Hayes, and Eric Sheppard

Information Technology Career Interest: Cross-cultural Study of College Women in Australia, New Zealand, & the United States

Carol J. Burger

Recruiting and Retention Strategies for Construction Employers in the United States

George Ford, P.E., EdD, Jack Patterson, PhD and Bradford Sims, PhD

A case study: an energy audit for a small municipality in North Carolina

Mr. George Ford, P.E. and Dr. Aaron Ball

Engineering Education as a Pathway to Sustainable Solutions

Elizabeth M. Hyde¹, Laura W. Lackey¹, Sam Harrell², and Nathaniel Robinson²

Independent Research in Dynamics, a Case Study in Student Learning

Hodge E. Jenkins

A VIEW on Mechanical Dissection for Freshmen Engineering

Priya T. Goeser, Wayne M. Johnson, Felix G. Hamza-Lup, Ivan Sopin, Michael Brundage and Matthew Carroll

Design of a Dust Collector Performance Experiment: An Extracurricular Student Project

Nicholas Harlow, Robert Choate, Joel Lenoir

Whatever Happened to Product Realization? Will Technology Programs Succeed Where Engineering Programs Have Failed?

John T. Berry, Taylan Altan, & John E. Wyatt¹
A Proposed Learner-Centered Mechatronics Engineering Instructional Program
Patrick Currier, Richard Goff, and Janis Terpenny

Using Camtasia Relay on a Tablet PC to Record Lectures in the Classroom: Experiences of a First-Time User
Steven M. Click, PhD, PE

Learning Statics: A Cognitive Approach
Chris Venters and Lisa McNair

Discovering Patterns in Student Activity on Programming Assignments
Anthony Allevato and Stephen H. Edwards

CoPractice: An Adaptive and Versatile Practice Tool
Kevin Buffardi, Dzmitry Churbanau, Rahul Kanna N. Jayaraman, & Stephen H. Edwards

Design and Build: Teaching Cognitive Skills through Tool Use
Eric Pappas and Robert Prins

Introducing High School Girls To PC Board Assembly
Jerry Newman

Marcos Chu

Engaging Current and Future Engineering Students Using PBS Design Squad
Sirena Hargrove-Leak

Techfacturing: A Summer Day Camp Designed to Promote STEM Interest in Middle School Students through Exposure to Local Manufacturing Facilities
Robert J. Prins, Sarah MacDonald, James Leech, Jonathan Brumfield, Michael Ellis, Lester Smith, and James Shaeffer

Introducing motor and gear calculations in a freshman-level design course
Philip T. McCreanor, Ph.D., Associate Professor

Enhancements to Software Defined Radio Design Engineering Education
Carl B. Dietrich, Frank E. Kragh*, S.M. Shajedul Hasan, Jeffrey H. Reed, Donna L. Miller*, and Stephen H. Edwards

Implementation and Evaluation of Laboratory/Tutorial Exercises for Software Defined Radio Education

Economical Classroom Laboratories for Material Science
David Domermuth, PhD

A Low Cost Conveyor System for Teaching Automation to Engineering Technology Students
Aaron K. Ball and Johnson S. Busick

LabVIEW-based Laboratory for Electronics Engineering Technology Program
Zhaoxian Zhou

Practice of Increasing Enrollment and Retention of Electronics Engineering Technology Program
Zhaoxian Zhou

Industry Partnerships at Western Carolina University: Live Projects that Work
William L. McDaniel and Aaron K. Ball

Methods for Increasing Enrollment in a Telecommunications Engineering Technology Program
Tom Fallon

SPEED – An ASEE Initiative for A Nationally Recognized Development Program for Engineering Educators
D. Schaefer, D.P. Visco, Jr., T.T. Utschig, J.P. Mohsen, N.L. Fortenberry, M. Prince, C. Finelli

Self-efficacy in female and male undergraduate engineering students: Comparisons among four institutions
Carol J. Burger, Joseph A. Raelin, Rachelle M. Reisberg, Margaret B. Bailey, and David Whitman

Elon’s Enhanced Engineering Dual Degree Program
Dr. Richard D’Amato

Implementing a Peer Leadership Model in a Large Scale Peer Mentoring Program
Rosemary Patterson and [Tyler Aarons, Erin Crede, Kaitlyn Hines, Jean-Louis Bile, Jared Chelko, Ryan Hubbard, Fleur Gooden, Whitney Edmister, Dr. Bevelee Watford]

Female Engineers at Mercer University; student recruitment, retention, and faculty involvement
Monika Bubacz, Aaisha Merali, Laura W. Lackey, Joan M. Burtner

Usability in Virtual Reality Construction Scheduling Education
Tulio Sulbaran, Ph.D, Andrew Strelzoff, Ph.D., Jian Chen Ph.D

A Learning Community Approach To Development Of A Sustainable Energy Course
Cortney V. Martin, Michael W. Ellis, David D. Dillard

Motivating Learning Performance in Collaborative Virtual Reality Environments
Tulio Sulbaran, Ph.D, Andrew Strelzoff, Ph.D.,

A Comedy of Errors: Teaching Oral Presentation Skills Using a Spectacularly Bad Presentation
Dr. Claire L. McCullough, PE

A System of Individualized Homework Assignments in Core Mechanics Courses
Ronald Goulet, Ph.D., P.E

An Introduction and Literature Review of Fuzzy Logic Applications for Robot Motion Planning
Mr. Paul Yanik, Dr. George Ford, Dr. William McDaniel

Measuring Achievement Goal Orientations of Freshman Engineering Students
Megan K. France1, Olga Pierrakos2, Javarro Russell1, Robin D. Anderson1

Commuter Students’ Educational Experiences and Sense of Belonging in the Undergraduate Engineering Community: A Phenomenological Study
Jenny Linn Smith and Julie Martin Trenor

High Altitude Student Ballooning Project: An Intensive Research Experience for Undergraduate Engineering Students
Atin Sinha
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Success – Oriented Needs Analysis: A Conceptual Framework</td>
<td>55</td>
</tr>
<tr>
<td>Tracee Walker Gilbert¹, Janis P. Terpenny¹²³, Sharnnia Artis⁴</td>
<td></td>
</tr>
<tr>
<td>Outreach Program in Civil Engineering and Traffic Safety for Fourth</td>
<td>56</td>
</tr>
<tr>
<td>and Fifth Grade Students</td>
<td></td>
</tr>
<tr>
<td>Rod E. Turochy</td>
<td></td>
</tr>
<tr>
<td>An Early Start to Studying Shaky Ground: Teaching Seismic Soil-</td>
<td>57</td>
</tr>
<tr>
<td>Structure Interaction Topics in a Sophomore-Level Dynamics Course</td>
<td></td>
</tr>
<tr>
<td>Fatih Oncul, Ph.D.</td>
<td></td>
</tr>
<tr>
<td>Preparing Students for the Practice of Civil Engineering</td>
<td>58</td>
</tr>
<tr>
<td>Thomas R. Dion, Kevin C. Bower, and Dennis J. Fallon</td>
<td></td>
</tr>
<tr>
<td>Capstone Courses: Why They Work and Why They Don’t</td>
<td>59</td>
</tr>
<tr>
<td>Michelle Rambo-Roddenberry, Ph.D., P.E., Kamal Tawfiq, Ph.D., P.E.,</td>
<td></td>
</tr>
<tr>
<td>and Marcus H. Ansley, M.S., P.E.</td>
<td></td>
</tr>
<tr>
<td>The Use of Clickers in Summer Undergraduate Civil Engineering Courses</td>
<td>60</td>
</tr>
<tr>
<td>Kenneth P. Brannan, Edward L. Hajduk, and John A. Murden</td>
<td></td>
</tr>
<tr>
<td>Reflections on Mentoring FIRST LEGO® League</td>
<td>61</td>
</tr>
<tr>
<td>Kyle Kelley, Janis Terpenny, and Richard Goff</td>
<td></td>
</tr>
<tr>
<td>Transportation – Learning on the Move</td>
<td>62</td>
</tr>
<tr>
<td>Dr. Jerry Everett</td>
<td></td>
</tr>
<tr>
<td>The Use of Modeling and Simulation as an Instructional Strategy in</td>
<td>63</td>
</tr>
<tr>
<td>High School Math and Science Classes</td>
<td></td>
</tr>
<tr>
<td>Mark A. Clemente</td>
<td></td>
</tr>
<tr>
<td>Empowering Teachers Through the Virginia 21st Century e-Teacher</td>
<td>64</td>
</tr>
<tr>
<td>Graduate Series</td>
<td></td>
</tr>
<tr>
<td>Sharon Bowers and K. Edwin Brown</td>
<td></td>
</tr>
<tr>
<td>A Third Year Update on a Single-Gender Outreach Program</td>
<td>65</td>
</tr>
<tr>
<td>Thomas E. Banning, Jerry D. Newman</td>
<td></td>
</tr>
<tr>
<td>Towards the Development of Programming Skills for First-Time-</td>
<td>66</td>
</tr>
<tr>
<td>Programmers</td>
<td></td>
</tr>
<tr>
<td>Ahmed Abukmail and Louise Perkins</td>
<td></td>
</tr>
<tr>
<td>Construction and Implementation of a Mobile Robot Platform in a</td>
<td>67</td>
</tr>
<tr>
<td>Microcontroller / Interfacing Class</td>
<td></td>
</tr>
<tr>
<td>Daniel Kohn</td>
<td></td>
</tr>
<tr>
<td>A Developmental Visualization Module that Starts with Inspection and</td>
<td>68</td>
</tr>
<tr>
<td>Ends at Solid Modeling Using Real Objects</td>
<td></td>
</tr>
<tr>
<td>Robert J. Prins and Keith Holland</td>
<td></td>
</tr>
<tr>
<td>Manuscript Publication Aided by the Open Journal Systems: A Case</td>
<td>69</td>
</tr>
<tr>
<td>Study</td>
<td></td>
</tr>
<tr>
<td>Nancy E. Study² and Robert A. Chin³</td>
<td></td>
</tr>
<tr>
<td>Blended Instruction in an Introductory Engineering Graphics Course:</td>
<td>70</td>
</tr>
<tr>
<td>Understanding How Students Utilize Online Instructional Resources</td>
<td></td>
</tr>
<tr>
<td>Theodore J. Branoff, Eric N. Wiebe, and Mark A. Shreve</td>
<td></td>
</tr>
<tr>
<td>An Experiment in Learner–Centered Instruction in Aerospace</td>
<td>71</td>
</tr>
<tr>
<td>Engineering Capstone Design</td>
<td></td>
</tr>
</tbody>
</table>
The Effect Knowledge Dissemination Structures Play in Increasing Design Efficiency in Small Design Teams
Aaron Noble, Richard Goff, and Janis Terpenny

Updating an old course: What does it take?
Zeshan Hyder, Zulfiqar Aly, Janis Terpenny, and Richard Goff

The Role of College Sponsored Freshman Projects Engaging Freshmen - Engaging Faculty
Cecelia M. Wigal, Ph.D. P.E.

An Undergraduate Nuclear Certificate Program
Shih-Liang (Sid) Wang

Semiotic Interface Design
Barbara V. Bernal

An Infrastructure for Teaching CS1 in the Cloud
Michael Woods, Godmar Back, and Stephen Edwards

Development of a Large Scale Virtual Meeting Space for Drug and Alcohol Aftercare Counseling

Source Code Plagiarism and the Honor Court
J. Patrick Van Metre and Stephen H. Edwards

Factors Affecting the Performance of Students in a Data Structures Course at Fort Valley State University
Ramana M. Gosukonda, Nabil Yousif, Masoud Naghedolfeizi

Greening the Educational Experience: Strategic Entry Points for Sustainability in the Existing Curricula
Annie R. Pearce and Yong Han Ahn

Situativity Approaches for Improving Interdisciplinary Team Processes
Kahyun Kim and Lisa D. McNair

Faculty Strategies for Facilitating Interdisciplinary Collaboration
David M. Richter and Marie C. Paretti

Faculty’s Self-Determined Engagement as the Key to Advancing a Culture of Assessment
Ken Stanton and Richard Goff

The Need for Adapting Engineering Education: Preparing Engineering Students for New Employment Environments a.k.a. Nuclear Power
Philip Kazemersky, Ph.D., PE

Interdisciplinary and experiential approach towards the teaching of materials science and engineering
Judy Schneider and Keisha Walters

Initiating the Undergraduate Research Study through the NYC-LSAMP Summer Fellowship
Sunghoon Jang and Kenneth Markowitz

An Updated Approach for Preparing Mechanical Engineering Students for the Machine Design Industry
Thong Do, Chase Holland, Drew Newman, Janis Terpenny, and Richard Goff

A Curricular Model for a One Semester Capstone Course in Engineering
Mohamad S. Qatu and E. William Jones
Achieve objectives of engineering design course through the jansen project and a design sample  
Yucheng Liu, Aaron Artigue

Etiology of the Energy Crisis in One Lecture  
B. K. Hodge

iGrads@VT: An iPhone Application for Graduate Recruitment  
Uma Murthy, Ben Hanrahan, Manuel A. Perez-Quinones, James Henry, and Ricardo Quintana-Castillo

Freshman Engineering Student Perceptions of Engineering Disciplines  
Paul J. Palazolo, Stephanie Ivey, Charles V. Camp

Faculty Student Advising at Western Carolina University  
Dr. George Ford, P.E. and Dr. Chip Ferguson

From the Classroom to the Operating Room: Cutting Edge and the Student  
Philip Kazemersky, PhD, PE, Joshua Stephenson, Ricky Thompson, Anthony Lopez, and Mena Aziz

CHAPTER 3 STUDENT POSTER ABSTRACTS .............................................................. 0

Open Channel Flow Apparatus  
T.C. Dinkins and Drew Hammett

Alternative On-Site Sewage Management: A Bench Scale System for Evaluating Filter Media  
Sarah Dorminy, Jacqueline Lagratta, Ryan Peters

Embry-Riddle Unmanned Search and Rescue System  
Savannah L Kirby and Noah J Potash

Microbial Fuel Cell Wastewater Treatment for Developing Nations  
Jamie Joyner and Leah Moore

Probabilistic Location of a Populated Chessboard Using Computer Vision  
Jason E. Neufeld and Tyson S. Hall

Time Domain Reflectometry and Water Level Measurement in Porous Media  
Jessica L. Pippard

Computational Micromechanics: Effective Electrical Conductivity of Carbon Nanotube-Polymer Nanocomposites  
Anne-Sophie Puydupin-Jamin and Gary Seidel

Flow Calorimeter: A Thermodynamic Demonstration  
Lauren E. Word and Emory Hannah

The Effect of Sample Storage Time and Temperature on Oxygen Uptake Rate Measurement  
Andrew Simms and Kristen Wyckoff

Detection of Trace Explosives by Photothermal Deflection Spectroscopy  
Jimmy Zahra, Ali Passian, Thomas Thundat, and Alejandro Suarez

CHAPTER 4 INDEX ........................................................................................................... 4-0
Chapter 1
Conference Information
7 April 2010

Dear 2010 ASEE Southeastern Conference Attendees:

On behalf of the faculty, staff, and students of the College of Engineering and the entire Virginia Tech University community, welcome to the 2010 ASEE Southeast Section Conference. If you have never visited with us, we hope you will find Virginia Tech and Blacksburg special places that you will choose to visit again. What a wonderful season of the year to be here!

Ten years ago we hosted the conference at our Hotel Roanoke facility. Now we think the convenience of our new Inn and Skelton Conference Center presents a better picture of life at our university and allows you to easily tour the campus and visit with colleagues and friends who are here in other colleges.

The theme of this year's conference, "The Engineering Educator of 2015," is certainly appropriate in light of the current date and the National Academy's well-known publication, "Educating the Engineer of 2020." A mere ten years separates this conference from that graduating class and the abstracts submitted demonstrate that our professional community is responding well. Another indication of that is the existence of specific departments or schools of engineering education such as we now have at Virginia Tech. That department did not exist ten years ago. We sincerely hope you will find time in your schedule to meet some of the graduate students and faculty in that department, many of whom are participating in the conference with you.

We are fortunate to have Dr. Dennis Hong as our keynote speaker. An internationally recognized expert on novel robotic locomotion systems, Dr. Hong has a passion for advising student design competition teams. In addition to numerous academic awards he is the inventor of the three-legged walking robot 'STrIDER' and the 'whole skin locomotion' inspired by amoeboid motility mechanisms. He is a pioneer in the use of inverting and nutating motion for locomotion in soft body robots.

These are exciting and challenging times in our field. Multiple events over the last decade have shaken us in ways we did not foresee. However, our profession is one that thrives on challenge and we always emerge better for it. That is who we are.

The current economic situation has impacted all of us and we want to thank you and your institutions for making the sacrifices necessary to be here.

Best regards,

Richard C. Benson
Dean of Engineering
Paul and Dorothea Torgersen Chair
Conference Welcome: Keith Plemmons, ASEE SE Section President

Everyone,

Welcome to the 2010 ASEE Southeastern Section (SE) Annual Conference: "The Engineering Educator of 2016". Now is the time to explore and reflect on what we are doing to produce a graduate engineer who is prepared and equipped to be an engineering educator. Our conference theme speaks to the need to look forward at the role we will play in producing the best “engineer of 2020”.

We have prepared an exciting program which highlights new educational practices and techniques. The workshops, technical sessions, group activities provide an excellent forum for information sharing and for building collaborative relationships. To all the participants, I thank you for being actively involved in your chapter and for making this sectional meeting a valuable and worthwhile experience.

We owe a world of thanks to the Site Committee at Virginia Polytechnic Institute and State University for planning and hosting this conference. Everyone is encouraged to explore and enjoy the campus and Blacksburg. In addition, I thank the section officers and those who worked to coordinate and deliver the technical program, peer-reviewed manuscripts, coordinated workshops, student poster sessions, prepared the Conference Book of Abstracts, reviewed award nominations, volunteered to moderate technical sessions, and performed all the other duties that make a conference successful. As Robert E. Lee once said, “Duty is the sublimest word in our language. You can never do more than your duty. You should never wish to do less.” My special thanks go to those individuals within the section that volunteered their time and talents to make this conference a success.

To the newcomers, I say welcome. You are part of the continuum of engineering educators who leave their mark on students eager to also leave their mark on their world. This should be an obvious theme as you participate in the technical sessions. We also want to welcome the undergraduate and graduate students who are participating in the conference technical sessions and/or poster session. We hope you consider a future that includes the professoriate. It is a worthy calling.

As your President, I do not have to remind you that the Southeastern Section is one of the most engaged and active sections in ASEE. We have a legacy of participation within the section and at our annual conference. In keeping with this legacy, I ask our new members to consider participating in your area of interest. Our continued success depends on people who understand the value of personal and professional growth through service.

To everyone, I look forward to seeing you at The Citadel in 2011. Springtime in Charleston is normally a wonderful time of the year, and I hear that the 2011 Site Committee is planning some special activities. So make your plans now for the 2011 ASEE-SE Annual Conference.

As I prepare to pass the gavel to the next President, I would like to thank everyone involved with ASEE SE and to all of those who came before us and who laid the groundwork for such a successful and inspiring organization. Thank you. See you in Charleston, SC in 2011.

Keith Plemmons
President ASEE-SE
Acknowledgements

The planning and execution of any conference such as this involves the hard work of many individuals and groups. I would like to express my sincere appreciate to:

- the 125 registered conference attendees representing 36 higher education institutions and 3 companies/institutions
- the 11 student teams in the poster competition
- all of the presenters in the technical sessions
- the Session Moderators
- Donna Raines, Sam Linkous, and Joanne Warren of the Continuing and Professional Education Department of VT
- Dr. Dennis Hong (Keynote Speaker)
- Dr. Paul Torgersen for his welcome address
- the staff at the Inn at Virginia Tech and Skelton Conference Center
- Keith Plemmons, Zhaoxian Zhou, Barbara Bernal and the members of the Executive Board for their guidance and planning
- All those conference sites who went before us that provided planning guidance and support
- Lisa Saul for her program cover design

I would especially like to thank our official sponsors, National Instruments and the Graduate Program of the VT Engineering Education Department.

It is a pleasure to serve you. If you need any assistance during the conference, stop by the Conference Registration area. Enjoy the conference and your time visiting Blacksburg.

Tom Walker
Conference Chair and Site Coordinator
## Monday, April 19, 2010

<table>
<thead>
<tr>
<th>Time</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:20 – 12:00 am</td>
<td><strong>T1-A</strong> RM Solitude</td>
<td><strong>T1-B</strong> RM Drillfield</td>
<td><strong>T1-C</strong> RM Smithfield</td>
</tr>
<tr>
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<td><strong>T1-D</strong> RM Duck Pond</td>
<td></td>
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</tr>
<tr>
<td><strong>Technical Session 1</strong></td>
<td>Instructional Division No. 1</td>
<td>Civil Engineering Division No. 1</td>
<td>Administrative Division No. 1</td>
</tr>
<tr>
<td>Moderator</td>
<td>Scott Schultz</td>
<td>Paul Palazolo</td>
<td>Cecelia Wigal</td>
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<td>Phil Kazemersky</td>
</tr>
<tr>
<td>01:40 – 03:20 pm</td>
<td><strong>T2-A</strong> RM Smithfield</td>
<td><strong>T2-B</strong> RM Solitude</td>
<td><strong>T2-C</strong> RM Duck Pond</td>
</tr>
<tr>
<td></td>
<td><strong>T2-D</strong> RM Drillfield</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Technical Session 2</strong></td>
<td>Mechanical Engineering Division No. 1</td>
<td>Instructional Division No. 2</td>
<td>K12 Outreach Division No. 1</td>
</tr>
<tr>
<td>Moderator</td>
<td>Autar Kaw</td>
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<td>Susan Nelson</td>
</tr>
<tr>
<td></td>
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<td>Robert Chin</td>
</tr>
<tr>
<td>03:20 – 03:40 pm</td>
<td><strong>T3-A</strong> RM Duck Pond</td>
<td><strong>T3-B</strong> RM Smithfield</td>
<td><strong>T3-C</strong> RM Solitude</td>
</tr>
<tr>
<td></td>
<td><strong>T3-D</strong> RM Drillfield</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Technical Session 3</strong></td>
<td>Engineering Technology Division</td>
<td>Administrative Division No. 2</td>
<td>Instructional Division No. 3</td>
</tr>
<tr>
<td>Moderator</td>
<td>Jerry Newman</td>
<td>Carol Burger</td>
<td>Tyson Hall</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ed Hajduk</td>
</tr>
</tbody>
</table>
## Tuesday, April 20, 2010

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:30 – 08:30 am</td>
<td>Breakfast and Division/Unit Meetings</td>
</tr>
<tr>
<td>08:30 – 10:10 am</td>
<td>Technical Session 4&lt;br&gt;Civil Engineering Division No. 2&lt;br&gt;K12 Outreach Division No. 2&lt;br&gt;Computer Engineering/Graphics Divisions&lt;br&gt;Instructional Division No. 4&lt;br&gt;Continuing the Dialogue Creating a Culture of Innovation in Engineering Education&lt;br&gt;Moderator: Fatih Oncul, Cindy Waters, Dan Kohn, Priya Goeser, J. P. Mohsen, Dennis Fallon</td>
</tr>
<tr>
<td>10:10 – 10:20 am</td>
<td>Break</td>
</tr>
<tr>
<td>10:20 – 12:00 pm</td>
<td>Technical Session 5&lt;br&gt;Software Engineering Division&lt;br&gt;Professional Skills Division No. 2&lt;br&gt;Chemical/Bio Engineering Divisions&lt;br&gt;Mechanical Engineering Division No. 2&lt;br&gt;Administrative Division No. 3&lt;br&gt;Moderator: Salame Amr, Ted Branoff, Sirena Leak, David Domermuth, Atin Sinha</td>
</tr>
</tbody>
</table>
Conference Overview

Sunday, April 18, 2010
12:00pm – 07:00pm  Conference Registration  Skelton Conference Center
01:00pm – 03:00pm  Workshop: Session 1  Randolph Hall Room 209
03:00pm – 05:00pm  Workshop: Session 5  Torgersen Hall Room 3060
03:00pm – 05:00pm  Executive Board Meeting  Randolph Hall Room 210
06:00pm – 08:00pm  Welcome Reception and BBQ  Torgersen Hall Room 1100

Monday, April 19, 2010
07:30am – 08:30 am  Conference Registration  Skelton Conference Center
07:30am – 08:30 am  Breakfast & Unit Meetings  Latham Ballroom A&B
08:45am – 10:00am  Welcome & Keynote Address  Skelton Assembly Hall
10:00am – 10:20am  Morning Break  Skelton 2nd Floor Foyer
10:00am – 12:00pm  Student Poster Session  Latham Ballroom D, E, & F
10:20am – 12:00pm  Technical Session 1 *  Skelton 2nd Floor Conf Rooms
12:00pm – 01:30pm  Lunch and Presentation  Latham Ballroom A&B
01:40pm – 03:20pm  Technical Session 2 *  Skelton 2nd Floor Conf Rooms
03:20pm – 03:40pm  Afternoon Break  Skelton 2nd Floor Foyer
03:40pm – 05:20pm  Technical Session 3 *  Skelton 2nd Floor Conf Rooms
06:00pm – 09:00pm  Reception and Award Banquet  Latham Ballroom A&B

Tuesday, April 20, 2010
07:30am – 08:30am  Breakfast & Division Meetings  Latham Ballroom A&B
08:30am – 10:10am  Technical Session 4 *  Skelton 2nd Floor Conf Rooms
10:10am – 10:20am  Break  Skelton 2nd Floor Foyer
10:20am – 12:00pm  Technical Session 5 *  Skelton 2nd Floor Conf Rooms
12:00pm – 1:30pm  Lunch & Business Meeting  Latham Ballroom A&B
01:30pm  Conference Adjourn

*All Technical Sessions in the Skelton Conference Center, 2nd Floor
All meals on Monday and Tuesday in Skelton Conference Center, 1st Floor, Latham Ballroom A&B
Technical Sessions

Monday, April 19, 2010 Technical Sessions 1, 2, & 3

**T1-A: Instructional Division No. 1**
**Moderator: Scott Schultz**
**Time: 10:20am - 12 noon**
**Room: Solitude**

Chapter 2 - 1. Improving Statics Instruction in Four-year Technology Programs by Dr. George Ford, P.E., Dr. John Patterson, Mr. Ronald Bumgarner

Chapter 2 - 2. A Student Survey of a Web-based Distance Learning Engineering Course by Scott Schultz

Chapter 2 - 3. Give them what they want: A look at student directed curriculum revision in a summer bridge camp by Leigh McCue, Tremayne Waller, Erin Crede, and Jonathan Gaines

Chapter 2 - 4. A Pre-Engineering Class to Help Transition Students Into an Engineering Major by Donna S. Reese, Robert Green, Missie Smith

Chapter 2 - 5. Development of Digital Audiovisual Lectures for an Engineering Course: A YouTube Experience by Autar Kaw, Sri Garapati

**T1-B: Civil Engineering Division No.1**
**Moderator: Paul Palazolo**
**Time: 10:20am - 12 noon**
**Room: Drillfield**

Chapter 2 - 6. Synergistic Learning & Inquiry through Characterizing the Environment for Sustainability (SLICES): Improving Understanding of Real World Systems through Observation & Reflection by Annie R. Pearce, Christine M. Fiori, Kathleen M. Short, and Vera Novak

Chapter 2 - 7. Undergraduate Civil Engineering Sustainability Education Metric (UCESEM): Benchmarking Civil Engineering Program Performance by Kathryn Augsburger and Annie R. Pearce

Chapter 2 - 8. Introducing Undergraduates to Load Calculations: A Course Designed Around ASCE-7 by Lori Koch, Richard Goff, and Janis Terpenny

Chapter 2 - 9. Interviews with Experts, in which they Explain how they Solved Structural Failure Investigations by Luis A. Godoy

**T1-C: Administrative Division No. 1**
**Moderator: Cecelia Wigal**
**Time: 10:20am - 12 noon**
**Room: Smithfield**

Chapter 2 - 10. Directions for Engineering and Technology Educators to Improve Program Enrollments by Dr. George Ford, P.E., Dr. William McDaniel, Mr. Paul Yanik

Chapter 2 - 11. Demographics and Diversity of Mercer University’s Graduate Engineering Programs by Richard O. Mines, Jr. and Greg Lofton

Chapter 2 - 12. Using a rubric-based assessment system to improve feedback and student performance in course-management systems by Bob Edmison and Stephen H. Edwards

Chapter 2 - 13. The Business of Engineering: Sharing Lessons on Motivating Potential Future Engineers by Otsebelo Nare, Ziette Hayes, and Eric Sheppard
### Chapter 2 - 14.
Information Technology Career Interest: Cross-cultural Study of College Women in Australia, New Zealand, & the United States by Carol J. Burger

### Chapter 2 - 15.
Recruiting and Retention Strategies for Construction Employers in the United States by George Ford, P.E., EdD, Jack Patterson, PhD and Bradford Sims, PhD

### Chapter 2 - 16.
A case study: an energy audit for a small municipality in North Carolina by Mr. George Ford, P.E. and Dr. Aaron Ball

### Chapter 2 - 17.
Engineering Education as a Pathway to Sustainable Solutions by Elizabeth M. Hyde, Laura W. Lackey, Sam Harrell, and Nathaniel Robinson

### Chapter 2 - 18.
Independent Research in Dynamics, a Case Study in Student Learning by Hodge E. Jenkins

### Chapter 2 - 19.
A VIEW on Mechanical Dissection for Freshmen Engineering by Priya T. Goeser, Wayne M. Johnson, Felix G. Hamza-Lup, Ivan Sopin, Michael Brundage and Matthew Carroll

### Chapter 2 - 20.
Design of a Dust Collector Performance Experiment: An Extracurricular Student Project by Nicholas Harlow, Robert Choate, Joel Lenoir

### Chapter 2 - 21.
Whatever Happened to Product Realization? Will Technology Programs Succeed Where Engineering Programs Have Failed? By John T. Berry, Taylan Altan, & John E. Wyatt

### Chapter 2 - 22.
A Proposed Learner-Centered Mechatronics Engineering Instructional Program by Patrick Currier, Richard Goff, and Janis Terpenny

### Chapter 2 - 23.
Using Camtasia Relay on a Tablet PC to Record Lectures in the Classroom: Experiences of a First-Time User by Steven M. Click, PhD, PE

### Chapter 2 - 24.
Learning Statics: A Cognitive Approach by Chris Venters and Lisa McNair

### Chapter 2 - 25.
Discovering Patterns in Student Activity on Programming Assignments by Anthony Allevato and Stephen H. Edwards

### Chapter 2 - 26.
CoPractice: An Adaptive and Versatile Practice Tool by Kevin Buffardi, Dzmitry Churbanau, Rahul Kanna N. Jayaraman, & Stephen H. Edwards

### Chapter 2 - 27.
Design and Build: Teaching Cognitive Skills through Tool Use by Eric Pappas and Robert Prins

### Chapter 2 - 28.
Introducing High School Girls To PC Board Assembly by Jerry Newman

### Chapter 2 - 29.
Chapter 2 - 30. Engaging Current and Future Engineering Students Using PBS Design Squad by Sirena Hargrove-Leak

Chapter 2 - 31. Techfacturing: A Summer Day Camp Designed to Promote STEM Interest in Middle School Students through Exposure to Local Manufacturing Facilities by Robert J. Prins, Sarah MacDonald, James Leech, Jonathan Brumfield, Michael Ellis, Lester Smith, and James Shaeffer

**T2-D: Electrical/Industrial Division No. 1**  
**Moderator:** Robert Chin  
**Time:** 1:40pm - 3:20pm  
**Room:** Drillfield

Chapter 2 - 32. Introducing motor and gear calculations in a freshman-level design course by Philip T. McCreanor


Chapter 2 - 35. Economical Classroom Laboratories for Material Science by David Domermuth, PhD

**T3-A: Engineering Technology Division No. 1**  
**Moderator:** Jerry Newman  
**Time:** 3:40pm - 5:20pm  
**Room:** Duck Pond

Chapter 2 - 36. A Low Cost Conveyor System for Teaching Automation to Engineering Technology Students by Aaron K. Ball and Johnson S. Busick

Chapter 2 - 37. LabVIEW-based Laboratory for Electronics Engineering Technology Program by Zhaoxian Zhou

Chapter 2 - 38. Practice of Increasing Enrollment and Retention of Electronics Engineering Technology Program by Zhaoxian Zhou

Chapter 2 - 39. Industry Partnerships at Western Carolina University: Live Projects that Work by William L. McDaniel and Aaron K. Ball

Chapter 2 - 40. Methods for Increasing Enrollment in a Telecommunications Engineering Technology Program by Tom Fallon

**T3-B: Administrative Division No. 2**  
**Moderator:** Carol Burger  
**Time:** 3:40pm - 5:20pm  
**Room:** Smithfield

Chapter 2 - 41. SPEED – An ASEE Initiative for A Nationally Recognized Development Program for Engineering Educators by D. Schaefer, D.P. Visco, Jr., T.T. Utschig, J.P. Mohsen, N.L. Fortenberry, M. Prince, C. Finelli

Chapter 2 - 42. Self-efficacy in female and male undergraduate engineering students: Comparisons among four institutions by Carol J. Burger, Joseph A. Raelin, Rachelle M. Reisberg, Margaret B. Bailey, and David Whitman

Chapter 2 - 43. Elon’s Enhanced Engineering Dual Degree Program by Dr. Richard D’Amato

Chapter 2 - 44. Implementing a Peer Leadership Model in a Large Scale Peer Mentoring Program by Rosemary Patterson and [Tyler Aarons, Erin Crede, Kaitlyn Hines, Jean-Louis Bile, Jared Chelko, Ryan Hubbard, Fleur Gooden, Whitney Edmister, Dr. Bevelee Watford]
Chapter 2 - 45. Female Engineers at Mercer University; student recruitment, retention, and faculty involvement by Monika Bubacz, Aaisha Merali, Laura W. Lackey, Joan M. Burtner

T3-C: Instructional Division No. 3  Moderator: Tyson Hall
Time: 3:40pm - 5:20pm  Room: Solitude

Chapter 2 - 46. Usability in Virtual Reality Construction Scheduling Education by Tulio Sulbaran, Andrew Strelzoff, Jian Chen

Chapter 2 - 47. A Learning Community Approach To Development Of A Sustainable Energy Course by Cortney V. Martin, Michael W. Ellis, David D. Dillard

Chapter 2 - 48. Motivating Learning Performance in Collaborative Virtual Reality Environments by Tulio Sulbaran, Andrew Strelzoff

Chapter 2 - 49. A Comedy of Errors: Teaching Oral Presentation Skills Using a Spectacularly Bad Presentation by Dr. Claire L. McCullough, PE

Chapter 2 - 50. A System of Individualized Homework Assignments in Core Mechanics Courses by Ronald Goulet

T3-D: Research Division No. 1  Moderator: Ed Hajduk
Time: 3:40pm - 5:20pm  Room: Drillfield

Chapter 2 - 51. An Introduction and Literature Review of Fuzzy Logic Applications for Robot Motion Planning by Mr. Paul Yanik, Dr. George Ford, Dr. William McDaniel


Chapter 2 - 53. Commuter Students’ Educational Experiences and Sense of Belonging in the Undergraduate Engineering Community: A Phenomenological Study by Jenny Linn Smith and Julie Martin Trenor

Chapter 2 - 54. High Altitude Student Ballooning Project: An Intensive Research Experience for Undergraduate Engineering Students by Atin Sinha


Tuesday, April 20, 2010 Technical Sessions 4, & 5

T4-A: Civil Engineering Division No. 2  Moderator: Fatil Oncul
Time: 8:30am - 10:10am  Room: Duck Pond

Chapter 2 - 56. Outreach Program in Civil Engineering and Traffic Safety for Fourth and Fifth Grade Students by Rod E. Turochy

Chapter 2 - 57. An Early Start to Studying Shaky Ground: Teaching Seismic Soil-Structure Interaction Topics in a Sophomore-Level Dynamics Course by Fatih Oncul, Ph.D.

Chapter 2 - 58. Preparing Students for the Practice of Civil Engineering by Thomas R. Dion, Kevin C. Bower, and Dennis J. Fallon

Chapter 2 - 59. Capstone Courses: Why They Work and Why They Don’t by Michelle Rambo-Roddenberry, Kamal Tawfiq, and Marcus H. Ansley
Chapter 2 - 60. The Use of Clickers in Summer Undergraduate Civil Engineering Courses by Kenneth P. Brannan, Edward L. Hajduk, and John A. Murden

**T4-B: K12 Outreach Division No. 2**
**Moderator: Cindy Waters**
**Time: 8:30am - 10:10am**
**Room: Smithfield**

Chapter 2 - 61. Reflections on Mentoring FIRST LEGO® League by Kyle Kelley, Janis Terpenny, and Richard Goff
Chapter 2 - 62. Transportation – Learning on the Move by Dr. Jerry Everett
Chapter 2 - 63. The Use of Modeling and Simulation as an Instructional Strategy in High School Math and Science Classes by Mark A. Clemente
Chapter 2 - 64. Empowering Teachers Through the Virginia 21st Century e-Teacher Graduate Series by Sharon Bowers and K. Edwin Brown
Chapter 2 - 65. A Third Year Update on a Single-Gender Outreach Program by Thomas E. Banning, Jerry D. Newman

**T4-C: Computer engineering/Graphics Divisions**
**Moderator: Dan Kohn**
**Time: 8:30am - 10:10am**
**Room: Drillfield**

Chapter 2 - 66. Towards the Development of Programming Skills for First-Time-Programmers by Ahmed Abukmail and Louise Perkins
Chapter 2 - 67. Construction and Implementation of a Mobile Robot Platform in a Microcontroller / Interfacing Class by Daniel Kohn
Chapter 2 - 68. A Developmental Visualization Module that Starts with Inspection and Ends at Solid Modeling Using Real Objects by Robert J. Prins and Keith Holland
Chapter 2 - 69. Manuscript Publication Aided by the Open Journal Systems: A Case Study by Nancy E. Study1 and Robert A. Chin2

**T4-D: Instructional Division No. 4**
**Moderator: Priya Goeser**
**Time: 8:30am - 10:10am**
**Room: Solitude**

Chapter 2 - 71. An Experiment in Learner –Centered Instruction in Aerospace Engineering Capstone Design by W.M. Butler, J.P. Terpenny, and R.M. Goff
Chapter 2 - 72. The Effect Knowledge Dissemination Structures Play in Increasing Design Efficiency in Small Design Teams by Aaron Noble, Richard Goff, and Janis Terpenny
Chapter 2 - 74. The Role of College Sponsored Freshman Projects Engaging Freshmen - Engaging Faculty by Cecelia M. Wigal, Ph.D. P.E.
Chapter 2 - 75. An Undergraduate Nuclear Certificate Program by Shih-Liang (Sid) Wang

**T4-E:**
**Time: 8:30am - 10:10am**
**Room: Cascade A**
Continuing the Dialogue Creating a Culture of Innovation in Engineering Education
J. P. Mohsen, Dennis Fallon

**T5-A: Software Engineering Division No. 1  Moderator: Salame Amr**
**Time: 10:20am - 12noon  Room: Smithfield**

1. Semiotic Interface Design by Barbara V. Bernal
2. An Infrastructure for Teaching CS1 in the Cloud by Michael Woods, Godmar Back, and Stephen Edwards
4. Factors Affecting the Performance of Students in a Data Structures Course at Fort Valley State University by Ramana M. Gosukonda, Nabil Yousif, Masoud Naghedolfeizi

**T5-B: Professional Skills Division No. 2  Moderator: Ted Branoff**
**Time: 10:20am - 12noon  Room: Solitude**

1. Greening the Educational Experience: Strategic Entry Points for Sustainability in the Existing Curricula by Annie R. Pearce and Yong Han Ahn
2. Situativity Approaches for Improving Interdisciplinary Team Processes by Kahyun Kim and Lisa D. McNair
3. Faculty Strategies for Facilitating Interdisciplinary Collaboration by David M. Richter and Marie C. Paretti
4. Faculty’s Self-Determined Engagement as the Key to Advancing a Culture of Assessment by Ken Stanton and Richard Goff

**T5-C: Chemical/Bio Engineering Divisions  Moderator: Sirena Leak**
**Time: 10:20am - 12noon  Room: Drillfield**

2. Interdisciplinary and experiential approach towards the teaching of materials science and engineering by Judy Schneider and Keisha Walters
3. Initiating the Undergraduate Research Study through the NYC-LSAMP Summer Fellowship by Sungsoon Jang and Kenneth Markowitz

**T5-D: Mechanical Engineering Division No. 2  Moderator: David Domermuth**
**Time: 10:20am - 12noon  Room: Duck Pond**

2. A Curricular Model for a One Semester Capstone Course in Engineering by Mohamad S. Qatu and E. William Jones
3. Achieve objectives of engineering design course through the jansen project and a design sample by Yucheng Liu, Aaron Artigue
4. Etiology of the Energy Crisis in One Lecture by B. K. Hodge
Chapter 2 - 91. iGrads@VT: An iPhone Application for Graduate Recruitment by Uma Murthy, Ben Hanrahan, Manuel A. Perez-Quinones, James Henry, and Ricardo Quintana-Castillo

Chapter 2 - 92. Freshman Engineering Student Perceptions of Engineering Disciplines by Paul J. Palazolo, Stephanie Ivey, Charles V. Camp

Chapter 2 - 93. Faculty Student Advising at Western Carolina University by Dr. George Ford, P.E. and Dr. Chip Ferguson

Chapter 2 - 94. From the Classroom to the Operating Room: Cutting Edge and the Student by Philip Kazemersky, PhD, PE, Joshua Stephenson, Ricky Thompson, Anthony Lopez, and Mena Aziz
Technical Session Information

Session and Presentation Timing
Almost all sessions are scheduled for 4-5 presentations. Some technical sessions have sections with a non-uniform number of papers. This is a result of late cancellations and attempting to theme sessions. In order to facilitate movement between sections in a technical section, each paper in a given technical section will be allotted the same amount of time. The presentation start times are listed in the grid below. This includes the introduction time and a 2 minute question/answer period. If there is a no-show author in a session, a break will be called. **Papers should not be moved up or rearranged in sessions.**

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Instructions for Technical Session Moderator Chairs

**Be prepared to moderate the session.**
Arrive 10 minutes early to the room where the session you are moderating is being held. Meet the presenters as they enter the room and go over the pronunciation of their name. Make sure all presentations are loaded and ready to go before the session starts. Bring a watch.

**Provide presentation guidelines at the beginning of the session.**
Introduce yourself at the beginning of the session. Remind presenters of the time limitations and that you will give a hand signal to warn that there are 5 minutes and then 2 minutes remaining.

**Introduce each presenter or presenters prior to their presentation.**
At the end of each presentation, the next speaker should come up and ready their slide show. Introduce the presenter when ready.

**Maintain the presentation schedule.**
One primary responsibility of the moderator is to ensure that the presenters begin and finish their presentations on time according to the technical program. Maintaining the presentation schedule within the session allocated time helps to have fair treatment for all presenters. In the event that a presenter, who is not last in the hour, is not present or has canceled, please wait to begin the next paper at the scheduled time, so that all who planned to attend the remaining paper(s) can. The moderator has the authority to stop a presentation that is about to run overtime in a respectful manner. It is also the job of the presenter to prepare to fit the presentation in the allotted time. Try your level best to not let a presentation and Q&A overrun the allotted time.
Student Poster Session Information

The Research Division is offering the 4th annual Student Poster Competition, immediately after the Monday morning keynote address. The posters will be located in the Prefunction II. Students may set up their posters immediately following the keynote address with judging taking place shortly from 10:30-12:00. The poster exhibits will be open to the public from 1:45-3:30. Awards and certificates will be presented during the Monday evening awards banquet for the following categories:

- Freshman/Sophomore Engineering and/or Engineering Technology Design Teams
- Junior/Senior Engineering and/or Engineering Technology Design Teams
- Undergraduate Research

The Student Poster Competition gives undergraduate students the opportunity to (1) share their research/project work with students and faculty from other institutions and (2) practice their visual, written, and oral communication skills in a professional/conference environment. The goals of the competition are to (1) improve the visibility of student efforts, (2) recognize excellence in student projects, and (3) promote the sharing and exchange of ideas about team projects and undergraduate research among the members in the section.

Student Poster Competition Abstracts
The Southeastern Section of the American Society of Engineering Education (ASEE) has solicited extended abstracts from undergraduate students to present in a poster session at this year’s conference.

Section 3 in this book contains the extended abstracts from this year’s student participants. During a morning judging section, they will be evaluated on their abstract, poster, and communication skills. In the afternoon, the Research Division encourages all conference attendees to stop by and learn from students about the wonderful projects going on throughout the section.

Poster Specifications
Each poster shall be set on one easel. Posters shall be of standard presentation student presentation quality (typically made of corrugated cardboard), and shall stand on their own when opened. Participants may use tape, glue, or pushpins to make attachments to the poster. Special, professionally fabricated presentation displays will NOT be allowed. All supporting display material shall fit on the table with the poster in the space provided. Electrical power will not be supplied.
SKELETON CONFERENCE CENTER LAYOUT

SECOND FLOOR CONFERENCE ROOMS

FIRST FLOOR BALLROOMS
Conference Workshops

Sunday, April 18, 2010, 1:00 – 3:00 pm
Introduction to BioMEMS on a Shoestring – 209 Randolph Hall
This 2 hour workshop is being presented by Kevin Seale and Ron Reiserer of Vanderbilt University. It will provide the background and basic information about microfabrication for investigators wishing to begin educational and research projects in biomicroelectromechanical (bioMEMS) devices. The workshop consists of a brief presentation followed by hands-on design and fabrication of microfluidic devices using inexpensive shrinky-dinks and inkjet printers.

Sunday, April 18, 2010, 3:00 – 5:00 pm
Hands-on With National Instrument’s LabVIEW and Multisim – 3060 Torgersen Hall
This 2 hour workshop is being presented by Eric Dean of National Instruments and will cover the following:
Multisim:
1. Creating a circuit schematic from scratch
2. Learn the component library tools
3. Perform interactive simulations
4. Export schematic to Ultiboard for PCB layout

LabVIEW:
1. Build a Virtual Instrument front panel and block diagram from scratch
2. Learn the editing and debugging tools
3. Set up a data acquisition task
4. Use both graphical and textual forms of signal processing
Dr. Dennis W. Hong
Director of RoMeLa: Robotics & Mechanics Laboratory
Associate Professor, Mechanical Engineering, Virginia Tech
Title - From Odin to DARwin: Robot Evolution by Intelligent Design

Dennis Hong is an Associate Professor and the Director of RoMeLa (Robotics & Mechanisms Laboratory) of the Mechanical Engineering Department at Virginia Tech. His research focuses on robot locomotion and manipulation, autonomous vehicles and humanoid robots. He is the inventor of a number of novel robots and mechanisms, including the ‘whole skin locomotion’ for mobile robots inspired by amoeboid motility mechanisms, a unique three-legged waking robot STriDER, an air-powered robotic hand RAPHaEL, and the world’s first car that can be driven by the blind. His work has been featured on numerous national and international media. Among Hong’s past honors is the National Science Foundation’s CAREER award, and the SAE International’s Ralph R. Teetor Educational Award. Additionally, he has been named to Popular Science's 8th annual “Brilliant 10”, honoring top scientists younger than 40 years of age from across the United States, and also named as a 2009 “Forward Under 40” honoree by the University of Wisconsin–Madison Alumni Association.

Dr. Hong also actively advises student teams for various international robotics and design competitions winning numerous top prizes including the DARPA Urban Challenge where they won third place and the $500,000 prize (2007), and the RoboCup, the international autonomous robot soccer competition where his team was the very first and only team to ever qualify for the Humanoid division from the United States (2007). Dr. Hong received his B.S. degree in Mechanical Engineering from the University of Wisconsin-Madison (1994), his M.S. and Ph.D. degrees in Mechanical Engineering from Purdue University (1999, 2002).
Keynote Abstract

Most mobile robots we see today utilize wheels or treads to move around. But why don’t we see such locomotion mechanisms in nature? Or a better question we should ask is: why don’t we use locomotion mechanisms used in nature for creating robots? Animals move in various ways; crawling, walking, jumping, and undulating to name a few. Inspired by biology, when and how should we apply these concepts to create robots with higher mobility? Bioinspiration does not mean simply copying ideas from nature, but rather learning the mechanisms behind it and being inspired by them to create novel concepts and solutions that go even beyond what we see in nature.

In this talk, we present several biologically inspired mobile robots developed at RoMeLa (Robotics & Mechanisms Laboratory) between 2004 and 2009, including a unique everting robot inspired by the motility mechanisms of amoebae, a rock climbing robot that uses matching behavior, an actuated spoke wheel system for unstructured environments, a hexapod crawler with dry adhesive feet for zero gravity space applications, an autonomous wheeled vehicle that can drive itself in the urban environment, a novel three legged robot that walks more like a human, a scaffolding climbing serpentine robot that rolls up to move, and an autonomous bipedal humanoid robot that can even play a game of soccer. The ability of robots created with bioinspiration can go even beyond that of animals in nature.
Conference Sponsors

We appreciate the generous support of:

National Instruments
National Instruments transforms the way engineers and scientists around the world design, prototype, and deploy systems for test, control, and embedded design applications. Using NI open graphical programming software and modular hardware, customers at more than 30,000 companies annually simplify development, increase productivity, and dramatically reduce time to market. From testing next-generation gaming systems to creating breakthrough medical devices, NI customers continuously develop innovative technologies that impact millions of people.

Graduate Program – Engineering Education Department – Virginia Tech
The Virginia Tech Engineering Education doctoral program incorporates theory with real-life application so that students are prepared to be teachers and scholars in the evolving field of engineering education. Based upon research in teaching and learning in engineering contexts, the graduate program combines established educational research methods with a thorough understanding of specific engineering content and practice. The Department of Engineering Education has cultivated core research strengths in professional skills (interdisciplinarity, communication, cross-cultural competence), design education, and first-year courses. Retention, diversity, and assessment are important foundational concepts in the field of engineering education; as such they are elements of all its projects.
# ASEE Southeastern Section Officers

## Executive Board Members

- **President** ……………………………………….. Keith Plemmons
- **President-Elect** ……………………………… Claire McCullough
- **Immediate Past President** …………………….. Barbara Bernal
- **Vice-President (Programs Unit)** ……………… Brent Jenkins
- **Vice-President (Awards & Recognition Unit)** ………… Paul Palazolo
- **Vice-President (Publications & Promotions Unit)** ………… Priscilla Hill

## Other Officers

- **Newsletter Editor/Webmaster** ………………….. Ken Brannan
- **Proceedings Editor** ……………………………… Barbara Bernal
- **Campus Representative Coordinator** …………… Thomas Dion

## Unit and Division Officers

<table>
<thead>
<tr>
<th>Unit</th>
<th>Chair</th>
<th>Vice-Chair</th>
<th>Secretary</th>
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<tr>
<td>Programs</td>
<td>Brent Jenkins</td>
<td>Zhaoxian Zhou</td>
<td>Scott Schulz</td>
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<td>Awards &amp; Recognition</td>
<td>Paul Palazolo</td>
<td>Tyson Hall</td>
<td>Alice Scales</td>
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<td>Publications &amp; Promotions</td>
<td>Priscilla Hill</td>
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<td>Administrative</td>
<td>Scott Yost</td>
<td>John Brocato</td>
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<td>Bioengineering</td>
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<td>Kevin Seale</td>
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<td>Chemical Engineering</td>
<td>Adrienne Minerick</td>
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<td>Jennifer Pascal</td>
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<td>Computer Engr &amp; Tech</td>
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<td>Petros Katsioloudis</td>
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<td>Engineering Technology</td>
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<td>Thomas Banning</td>
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<td>Scott Schultz</td>
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<td>Tyson Hall</td>
<td>Dick Kunz</td>
<td>Michael Woo</td>
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<td>Dirk Schaefer</td>
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<td>Professional Skills</td>
<td>Peter Hoadley</td>
<td>Paul Palazolo</td>
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<td>Research</td>
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<td>Cindy Waters</td>
<td>David Domermuth</td>
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## ASEE SE 2010 Conference Registrants

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Chapter 2  Extended Abstracts
Improving Statics Instruction in Four-year Technology Programs

Dr. George Ford, P.E., Dr. John Patterson, Mr. Ronald Bumgarner

ABSTRACT - Four-year engineering technology students often find their first course in Statics to be most challenging. This paper discusses a study of students’ performance in algebra and trigonometry-based Statics courses over a three semester period of time. The purpose of the study was to determine if students in a mini-semester, 12 day long course performed as well as students in a traditional, 16 week long semester.

The discussion includes a short literature review and an examination of the steps taken to monitor the performance of Statics classes provided to technology and construction management students. Student Scholastic Aptitude Test scores were found to be statistically equal for all three classes. Students’ performance on a standard, multiple choice final exam in all three classes was also statistically equivalent. It appears that a shortened, intense period of study did not have any detrimental effects upon student performance when the class size was kept small.

Keywords: Statics, beam design, column design, student retention, strength of materials
A Student Survey of a Web-based Distance Learning Engineering Course

Scott Schultz

Mercer University
School of Engineering

In this paper, results of a student survey are presented for a web-based distance learning engineering course taught at Mercer University. All students who took the course felt the course was appropriate for distance learning and would recommend the course to fellow classmates. However, they felt only about 10-15% of engineering courses could viably be taught through distance learning. Students cited flexibility and convenience as the primary advantages for distance learning. Additional survey questions focused on the value of various electronic materials used during the course.
Give them what they want: A look at student directed curriculum revision in a summer bridge camp

Leigh McCue, Tremayne Waller, Erin Crede, and Jonathan Gaines

Virginia Tech/Cornell University/Virginia Tech/Virginia Tech

Extended Abstract

This paper presents the survey results and implementation methodology used in revising the introductory engineering portion of the Virginia Tech Center for the Enhancement of Engineering Diversity’s STEP Bridge summer camp. In the spring semester of 2009, students from the 2008 STEP Bridge camp were surveyed on their first semester freshman year academic experience. Targeted questions solicited students’ level of comfort with various concepts and software. Students were specifically asked which topics from their first semester engineering course they wished they had greater exposure to during the summer. And lastly, students were prompted to compare level of effort and test format between the summer program and their fall course. This student feedback was used to drive curriculum revision of the engineering component of the STEP Bridge summer camp. The 2009 STEP Bridge camp participants were then surveyed on their first semester freshman year academic experience in the spring semester of 2010.

The STEP program aims to support and aid in the development of students through non-credit bearing college courses that focus on content that has been historically difficult for first-term students (chemistry and chemistry lab, math, and engineering). The program aids students in developing better time management skills and academic strategies to be successful in college. It also provides students with vital opportunities to become acclimated to more rigorous, complex, or ambiguous material during courses designed to mimic what they will experience during their fall freshman term. The program gives students an opportunity to familiarize themselves with the institution and the community prior to their academic year. Finally, the program provides students with personal and professional development through various activities both on- and off-campus.

One component of the STEP summer camp is an engineering fundamentals portion, STEP ENGE. The primary mission of the STEP ENGE course is to prepare students for their freshmen year engineering classes; as such the key components include familiarization with technology and software used in the curriculum, engineering coursework, and hands-on, engineering, team-oriented activities. A student survey instrument was developed and data used to revise the STEP ENGE curriculum. The survey instrument, curricular revisions, and student feedback are described in the full paper.
A Pre-Engineering Class to Help Transition Students Into an Engineering Major

Donna S. Reese, Robert Green, Missie Smith
Mississippi State University

Extended Abstract

In the fall of 2001, the Bagley College of Engineering at Mississippi State University instituted admissions criteria into the college. Students who are admitted into the university expressing an interest in engineering who do not meet these criteria are admitted as undecided majors with a pre-engineering concentration. The admissions criteria were established by studying the graduation rates of students entering the college and are a combination of high school GPA and ACT scores. Students in this designation are advised by a special advisor in the academic advising center and can be admitted to engineering upon successful completion of their freshman year and several specific courses. Approximately 100 students annually are admitted with this designation and minority students are a disproportionately large part of this group.

In 2005 we conducted a study of the students in this designation to determine how many transitioned into an engineering major. This study determined that very few of these students ever successfully gained admission into engineering. In addition, many of these students ended up with GPAs that kept them from being admitted to other majors as well.

In the spring of 2006 the college instituted a one-hour Intro to Engineering class for this group of students. This class has enrolled a total of 188 students in four offerings since this time. This course includes an overview of each of our engineering majors as well as personal development topics such as study skills, time management, technical communications and learning styles. This course covers basic college success skills for students as well as an overview of the different engineering disciplines available at Mississippi State University. The syllabus for the class as well as the assignments and grading scheme are covered in the paper.

This class has seemed to help more of the pre-engineering students to successfully transition into an engineering major. However, the academic success of this group of students does not appear to be positively impacted by this class. The results of our data analysis will also be covered in this paper.
Development of Digital Audiovisual Lectures for an Engineering Course: A YouTube Experience

Autar Kaw, Sri Garapati

Department of Mechanical Engineering, University of South Florida

Extended Abstract

In 2008, NSF published a task-force report on cyberlearning (defined as “learning that is mediated by networked computing and communications technology”). The writers of this report emphasized that cyberlearning can transform education as it offers a new approach to learning by offering the content through multiple context and platforms. In the same year, the National Academy of Engineers [2] came up with a list of 14 challenges for the 21st century, and one of those challenges is Advanced Personalized Learning. This is an acknowledgment that each of us learns differently and that we need to make instruction individualized for reliable learning.

Since 2002, NSF has funded the author and his colleagues with four multi-university consecutive grants to develop, refine, assess, and disseminate multiple online resources (http://numericalmethods.eng.usf.edu) for a course in Numerical Methods. The resources for a typical Numerical Methods course are now complete.

As part of the multiple-context and multiple-platform development, in Spring 2009, lecture videos for a whole course in Numerical Methods were placed on YouTube (http://www.youtube.com/numericalmethodsguy). In this paper, we discuss the complete experience of the development of these videos.

More than 200 short modular videos are currently available that cover the syllabus of a typical Numerical Methods course. An initial assessment of these resources is made via the video analytics tool made available by YouTube. This assessment shows increasing popularity of the videos, but also gives insight into the audience attention, and demographics by gender, age, and geography. In addition to the above statistics, each video is rated and commented on by logged-in users. This gives a qualitative sense of how the videos are being accepted by the general audience.

Acknowledgement

This material is based upon work supported by the National Science Foundation under Grant No 0717624 and 0836981, and the Research for Undergraduates Program in the USF College of Engineering. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.
Synergistic Learning & Inquiry through Characterizing the Environment for Sustainability (SLICES): Improving Understanding of Real World Systems through Observation & Reflection

Annie R. Pearce, Christine M. Fiori, Kathleen M. Short, and Vera Novak
Virginia Tech

Extended Abstract

There is a gap in engineering education with regard to understanding the human or social barriers to sustainability that inhibit the successful implementation of engineering solutions in practice. A broad set of cognitive and affective sustainability skills and competencies are necessary to achieve this understanding, and the complementary constructs of information literacy and managerial resourcefulness combine with these skills to create the sustainability-literate engineer of tomorrow.

This paper presents initial results of research on modes of learning combining undergraduate research with work-based learning or internships to create a program for Synergistic Learning & Inquiry through Characterizing the Environment for Sustainability (SLICES). The aim of this research is to combine these two types of experiential learning into an inquiry-based internship experience that builds on existing strong institutional programs at Virginia Tech, aligns well with the goals of all participants, and taps a larger, more diverse body of students than is typically able to be reached by undergraduate research programs alone.

The objectives of the research are to fill gaps in the existing knowledge base about the impacts of such programs on diverse student populations, the efficacy of hybrid experiential learning methods for sustainability pedagogy, and the role of such programs in setting the stage for positive change toward sustainability in industry. The point of departure for the proposed research is based on preliminary findings from a pilot test of the model at Virginia Tech in 2007. A three-pronged assessment design is being used to evaluate the influence of the SLICES program using alumni studies, student learning assessment, and assessment of impact on industry participants. The paper presents findings from the pilot study along with progress on the subsequent research design and initial findings of the study.
Undergraduate Civil Engineering Sustainability Education Metric (UCESEEM): Benchmarking Civil Engineering Program Performance

Kathryn Augsburger and Annie R. Pearce

Virginia Tech

Extended Abstract

Civil engineers design and execute new construction from support infrastructure such as water pipelines, roads, and bridges to suburban housing and metropolitan high-rises. Colleges and universities have the responsibility to prepare new civil engineers with the toolbox they will need in order to succeed in the workforce, yet they continue to provide sporadic education of sustainable design and construction practices. This is due, in part, to the difficult-to-quantify, context-dependent, and non-standardized nature of sustainable engineering instruction, and the missing incentive toward the aggressive pursuit of implementation.

The annual U.S. News and World Report issue on ‘America’s Best Colleges’ is a recognized metric reporting how colleges ‘rack and stack’ against each other. While there is some controversy as to the appreciated validity of these rankings, in an effort to maintain their competitiveness for quality students, colleges will alter their programs in relation to ranking criteria. Similarly, the College Sustainability Report Card, also known as the ‘Green Report Card’, established with its first report on sustainability in 2006, evaluates the quality and comprehensiveness of the campus sustainability practices of 300 institutions. While the resulting ‘grades’ motivate college administrators to surpass their competitors, no similar metric exists to measure performance of a program with regard to sustainability education.

This paper describes the development of such a comparative metric, modeled after the U.S. News and World Report system and the Green Report Card, for undergraduate civil engineering sustainability education. A review of existing literature, case studies, and attitudinal reports, while considering feasibility of program data collection, are included as factors toward metric criteria identification. The metric is demonstrated using recent university data derived from a national benchmarking report of engineering programs and prior year Green Report Card data.
Introducing Undergraduates to Load Calculations: A Course Designed Around ASCE-7

Lori Koch, Richard Goff, and Janis Terpenny

Civil and Environmental Engineering / Engineering Education / Engineering Education and Mechanical Engineering – Virginia Tech

Extended Abstract

More often than not, undergraduate students in structural engineering programs are only briefly exposed to ASCE-7 (Minimum Design Loads for Buildings and Other Structures), usually in the introduction of concrete or steel design courses. In junior-level design courses, the loads on a structure are usually presented as a “Given” to the students, but the importance of understanding how to determine design loads on a structure is seldom emphasized. To be most effective, students need to be introduced to design load calculations prior to their senior-level courses when some level of competence is needed to apply these concepts and methods in design projects and capstone courses.

Graduate-level courses on this topic are offered at some universities, and allow the instructor to provide more in-depth information and more extensive discussions on advanced topics such as seismic loads. These graduate courses may provide some insight into the design of a course for undergraduates. While some of the higher level information would need to be omitted in order to make the course more manageable and suitable for the level of undergraduate students, some of the fundamental content could be combined with other practical information such as specification of pre-engineered components, plan reading, and site visits.

This paper provides an overview of a new course designed to introduce undergraduate students to load calculations, designed around ASCE-7. A description of the course structure along with course topics and course project are provided.
Interviews with Experts, in which they Explain how they Solved Structural Failure Investigations

Luis A. Godoy
Director, Civil Infrastructure Research Center, and Professor, Department of Civil Engineering and Surveying, University of Puerto Rico, Mayaguez, Puerto Rico 00681-9041. E-mail: luis.godoy@upr.edu

Extended Abstract

The goal of this research is to identify what topics and procedures should be taught to engineering students in order to help them work in the field of analysis of structural failures. To identify knowledge and procedures, structured, face-to-face interviews were conducted to expert engineers, with emphasis on their methodology of research and their thinking about causes of failure. The experts were practicing engineers who have accumulated experience on the investigation of structural failures, with either Ph.D. or P.E. credentials. Our main interest was to identify how experts carry out the construction of failure hypothesis. It is currently believed that experts do that by using what was learned from interventions in past cases in which they were involved. Due to limitations in our access to experts, the questionnaire was formulated to be completed in one session (rather than having several sessions, each with a specific goal). The list of questions was divided into: (a) General questions about the relation between the expert and her work; (b) Questions about a specific case in which the expert was involved; (c) Questions about the methodology used in this investigation; and (d) Questions about the development of failure hypothesis in this case. Open questions were formulated to give the possibility of having an extended discussion on the question domain. A typical interview took one hour. When de-constructing interviews, each expert becomes a case and the knowledge extracted is better framed within some structure, in this case, provided by Cased-Based Reasoning. Unlike what is commonly believed, experts do not find cases that are even similar to the one that they describe. Thus, what they can use are their knowledge about the structure that failed and knowledge and concepts of structural behavior and failure investigation, but they could not construct an analogy with previous cases that would lead to the solution of the new case. The idea of solving a puzzle seems to be closer to the work done by this group of experts, in which structural analysis plays an important role in identifying the solution. One of the future outcomes expected from this research will be the creation of educational tools in which the students can do and experience in a simulated environment, without the dangers of having undesirable consequences to the specific case investigated or to their own future.
Directions for Engineering and Technology Educators to Improve Program Enrollments

Dr. George Ford, P.E., Dr. William McDaniel, Mr. Paul Yanik

Abstract - In addition to weak enrollments, engineering technology educational programs typically lack diversity among their student bodies [10]. In the Physics and Engineering undergraduate fields in the United States, women for instance, make up only 20% of the population, and in graduate programs, the gap is even wider than the 50:50 ratio one would expect [13]. Reduced enrollments and a lack of diversity create a challenge for engineering and technology program faculty members. Engineering and engineering technology educational program operators and faculty members are under pressure to find ways to increase enrollment and graduation rates in spite of budgetary restraints. The discussion that follows investigates the current status of engineering education in the United States, past trends of engineering education, and avenues of improvement for engineering educators as they pertain to two-year, and four-year engineering and engineering technology programs.

Keywords: student recruiting, student retention, diversity, STEM
Demographics and Diversity of Mercer University’s Graduate Engineering Programs

Richard O. Mines, Jr. and Greg Lofton

Mercer University / Mercer University

Extended Abstract

The Mercer University School of Engineering (MUSE) in Macon, Georgia offers a Master of Science in engineering degree in seven engineering disciplines: biomedical (GBE), computer (GCE), electrical (GEE), engineering management (EGM), environmental (GEV), mechanical (GME), and software (SFE). These programs are designed for students with an undergraduate degree in engineering. A dual-degree program is available for outstanding junior engineering undergraduates who may receive both their Bachelor of Science and Master of Science at the end of their 5th year of study. A Master of Science degree is awarded in four other associated engineering programs: environmental systems (GES), Software Systems (SFS), Technical Communication Management (TCC) and Technical Management (TCM). Students that do not have an undergraduate degree in engineering pursue these associated engineering programs. Both the environmental engineering and environmental systems graduate programs were started Fall 2009.

The purpose of this paper was to investigate the demographics and diversity of the student-body at the Mercer University Graduate School of Engineering. Data used in developing this paper is based on the academic years beginning 2002-03 and ending 2008-09. The major findings of this study are summarized as follows:

1. 1837 students were enrolled in graduate engineering programs during these 7 academic years.
2. The average percentage of students enrolled by race was 4% Hispanic, 9% African American, 11% Asian, 17% unknown, and 59% White.
3. 75% of students enrolled were male and 25% female.
4. During the 7 academic years, 71 MS degrees were awarded and 171 MSE degrees awarded.
5. The overall graduation rate of our graduate students was 55.8%. For students enrolled in the dual-degree program, 75% of those that started the program earned their degrees.
6. The gender of our students earning master’s degrees was 25% female and 75% male.
7. The overall grade point average of all graduates students was 3.74 on a 4-point scale.
Using a rubric-based assessment system to improve feedback and student performance in course-management systems

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Extended Abstract

Writing skills are critical to student success both in university as well as after graduation. The importance of feedback to students on writing assignments has been well established, but the typical feedback students receive on assignments submitted via a course management system (CMS) is disconnected from the actual content of the student’s work. As instructors move more towards managing assignments electronically, this disconnect has become more pronounced. Instructors have developed a variety of methods for providing feedback on electronically submitted assignments, but the bulk of these processes do not provide the feedback within the context of the original assignment. There have been some efforts to provide methods to markup assignments online, but those efforts have been limited to custom toolsets as opposed to additions to popular CMS packages. Another issue faced by instructors, centers on capturing the nature of the feedback students receive into a clear picture of the progress the class is making.

In this paper, we provide a review of the literature about the importance of feedback to the learning process, and develop the notion of contextual feedback, feedback that is provided within the context of both the learning situation as well as the learning content. We provide a theoretical bridge between learning theory and the theories underlying human-computer interaction. We review some of the existing tools that have sought to address the issue of contextual feedback. Finally, building on the authors’ previous work, we describe a new markup system we have developed that is a plug-in to the Moodle CMS that uses rubrics as a framework for guiding the feedback process. This new system provides a means of adding feedback within the context of an electronic submission, as well as capturing that feedback to be used by the instructor as an overview of the class’ performance on the assignment.
The Business of Engineering: Sharing Lessons on Motivating Potential Future Engineers

Otsebele Nare, Ziette Hayes, and Eric Sheppard

Hampton University

Extended Abstract

In the summer of 2007, Hampton University was awarded a United States Department of Energy pilot grant on developing engineering workforce leadership for the future. This paper reports on an approach that incorporates engineering and business concepts in a pre-college engineering summer program focused on exposing high performing minority high school students to engineering concepts and motivating them to consider engineering as a career. Since 2007, Hampton University has held a one-week summer academic enrichment program for high school students in collaboration with the Leadership Education and Development (LEAD). Each summer, the program has offered a series of interactive workshops, field trips, design contests, and a case study project. The activities fostered teamwork, the development of communication skills, and an opportunity to learn more about the world of engineering within an intellectually stimulating environment.

The program engaged students in problem solving and hands-on experience. The purpose of the program was aimed at (1) demonstrating interdependence of engineering and business in making real world choices, (2) engineering methodology as a means of problem solving, (3) exposing students to the entertaining, yet challenging world of engineering, (4) introducing students to cutting edge, computer-aided design (CAD) software used to solve day-to-day problems, and (5) teaching students teamwork skills.

The motivation and model of the business of engineering approach is presented in this paper along with post-program feedback and assessment from parents and students. Survey results on the students’ impression of and knowledge about engineering, including potential career choices are presented as well. Overall, the continuous post-program feedback from parents and students shows that exposing and motivating younger high school students to engineering is more effective. The paper also offers recommendations for future program adjustments that include expanded use of CAD tools in design contests, extended program length, and recruitment of younger students.
Information Technology Career Interest: Cross-cultural Study of College Women in Australia, New Zealand, & the United States

Carol J. Burger

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Extended Abstract

Underrepresentation of women in information technology (IT) fields in the United States, Australia, and New Zealand, among other countries, has been well established. However, there is a desire to increase the participation of women in IT college majors and careers because of a need for more IT workers, the aspiration of women to enter high income occupations, and the equity argument that women should have opportunities equal to their male peers. There has been a decline in women (and men) pursuing computer science degrees in these three countries and, because of this, Australia and New Zealand have seen their CS departments shrink or be eliminated. In this study of three English-speaking cultures, the goal was to examine how women view the IT field and its culture in terms of a viable career and how their background in computer use has led them to a college IT major.
Recruiting and Retention Strategies for Construction Employers in the United States

George Ford, P.E., EdD, Jack Patterson, PhD and Bradford Sims, PhD

Abstract - In the fall and spring semesters of 2008, graduating construction management students at Western Carolina University were surveyed to determine their expectations of aspects of working conditions in the construction industry. A previously developed survey instrument was used to partially replicate a study done in 2003 which determined positive recruiting and retention strategies for construction companies. The results of this study indicated that while new graduate expectations of construction employers are ever-changing, the most recently surveyed students generally had similar perceptions to those surveyed in 2003. The similarities in the economic climates during both periods may explain the similarities of the results of the two studies.

Keywords: employee retention, personnel retention, employee recruiting, hiring strategy, employee benefits
A case study: an energy audit for a small municipality in North Carolina

Mr. George Ford, P.E. and Dr. Aaron Ball

Abstract - Renewable resources, energy awareness, and energy conservation continue to be areas of concern that cannot be overlooked globally, nationally or locally. Western Carolina University is taking an active role in integrating energy conservation and auditing procedures in the Construction Management and Engineering Technology curricula. Students can be better prepared for entry into the workforce if knowledge and skills related to energy conservation and analysis are in place. This paper will describe an energy audit for a local municipality whose energy costs are reaching budgetary concerns for maintaining current levels of service. A discussion of the process used to conduct the energy audit for the local municipality will be presented, and recommendations to reduce the costs are provided. How the review and methodology is being used as a guide for students in the Kimmel School of Construction Management and Technology for performing energy audits will be presented.

Keywords: energy auditing, municipal budgets, community service, classroom enhancement
Engineering Education as a Pathway to Sustainable Solutions

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According to Mercer University’s Vision Statement, it seeks to be an institution “nationally renowned for providing a dynamic, diverse, and rigorous education where every student matters and learns to make a difference”. While that vision is realized in many different aspects of student life on campus, the President has specifically targeted to engage Mercer students in “transform[ing] communities locally and globally through University-community partnerships, service-learning, and volunteerism.” In pursuit of this goal, Mercer University administers a number of service-learning programs for its students, including degrees emphasizing public service, various high-impact student-led clubs, and Mercer On Mission—a course option for students that “blends service learning and study abroad”, providing class credit for students while they engage in “serving peoples and cultures around the world”.

Continuing in its strong tradition of academic excellence, the Mercer University School of Engineering instated a Masters of Science in Engineering degree for Environmental Engineering in the Fall 2009 Semester. The vision for this program would not be solely scholastic, but in working with Mercer on Mission, it would allow Environmental Engineering Master’s students to engage in hands-on experience, working closely with representatives from various developing countries and aiding these communities by providing sustainable designs to fit their needs. Guided by the United Nations’ “Millennium Development Goals”¹,² and the concept of “Quick Wins”, these projects will not only provide an unparalleled experience for the student, but more importantly, they will yield programs, solutions, and sustainable technology that will aid in the UN’s goal of reducing the effects of poverty by the year 2015.

The first project engaged in this program is in service of the Sisit community in the northwestern region of Rift Valley Province in Kenya. The main goal is the implementation of a design using a water-powered turbine pump that will deliver water diverted from an irrigation raceway to a nearby nursery school, as well as individual water filtration units for home use. A separate project for the neighboring community of Loongeiwuan will pursue sustainable methods of utilizing a slightly saline water supply for irrigation purposes. The vehicle for this project is again Mercer on Mission, serving through the “Kutana” and Development Initiatives programs of Africa Exchange³, an organization whose mission is to “exchang[e] information, ideas and resources across cultures to promote mutual understanding and respect, resulting in works of Christian compassion among the poor and marginalized in sub-Saharan Africa”. During the June 2009 trip to Kenya, the Mercer on Mission team scouted the current conditions of the canal where the pump will be installed, as well as the site of its delivery.

The main concerns to be addressed in the design of a solution for this Pokot community include providing a sustainable system that attends to the dramatic height difference from the source to the destination, water filtration, and storage. The system will be effective, while simple in construction and use, low cost, and composed of locally available materials. Research and testing will provide a better understanding of best filtration and pumping options, but current alternatives include a water-powered turbine pump, as well as pursuing possible solutions AquaClara International may provide for filtration needs.

Once completed, the designs for each aspect of the project—the water delivery system, filtration, and effective handling of saline water—will not only provide water for the people living in this particular Rift Valley community, but it will also serve as a model for other communities in need of similar simple and sustainable water systems.
Independent Research in Dynamics, a Case Study in Student Learning

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Extended Abstract

While the typical undergraduate student who pursues research is generally a top performer academically, less-gifted students might benefit from a conducting a research investigation of their own interest. This paper chronicles an independent study and research of a non-research oriented, student in a single semester independent project. The student (average to slightly below average academically) chose his problem for study, with the approval and guidance of a supervising faculty. The academic goals of this effort were to achieve an increased level of understanding in applications of dynamic systems modeling to design, simulation, and ultimately to answer an engineering design question, relating to the dynamics of a real system.

A motorcycle rear suspension design was the specific topic of the investigation. The student, a motorcycle rider, used the Honda Shadow VT750 Aero for the basis of his investigation, as it is a mid-size motorcycle that utilizes a standard motorcycle suspension design. The suspension components studied by the student researcher consisted of the front fork, and the rear swing arm. A standard design motorcycle suspension has a spring and damper on both sides of the fork and rear swing arm. Both the rear and the front suspension lines of action are offset from the vertical by an angle. The initial questions investigated by the student were “How does the angle of orientation affect the rider comfort and handling?” and “Is there a general design optimum possibly based on rider comfort characteristics?”.

Mainly through the process of developing an appropriate mathematical model, simulating road conditions (input), and examining simulation results the student had the opportunity achieve a higher level of knowledge and skill in dynamics and its application to engineering design, as well as develop critical thinking skills.

Although the results, conclusions, and recommendations revealed a less than a thorough investigation of the subject, they did demonstrate a more comprehensive grasp of modeling by the student. The student work is presented along with critiques and comments. Motivation by the student to perform the research seemed to be a significant factor in the final results.
A VIEW on Mechanical Dissection for Freshmen Engineering

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Extended Abstract

Mechanical dissection is an engineering activity that can satisfy a student’s curiosity of how and why the components of given devices can convey specific motions to achieve a desired result. Hence, several university engineering programs have developed mechanical dissection laboratories. However, such laboratories are not always feasible due to the lack of space, personnel, time and high costs. An emerging trend to address this issue is to use multi-media technology to replace/supplement physical laboratories. The objective of this work is to develop the second phase of VIEW (Virtual Interactive Engineering on the Web) which is a virtual mechanical dissection module. Virtual dissection/assembly implemented in VIEW would only require the use of existing computer laboratories. This module is used as a supplement in the course: Introduction to Engineering.

Introduction to Engineering (ENGR1100) is a 3-credit hour freshmen engineering course, in which students are introduced to the engineering process from problem formulation to the evolution of creative design. The objectives of this course are to excite students about engineering, cultivate problem-solving skills, encourage creativity, cultivate professionalism and emphasize the importance of communication skills. One approach to meeting these objectives is through the use of mechanical dissection/assembly activities.

The mechanical dissection module in VIEW consists of a 3D CAD model of a mechanical power toothbrush modified using SolidWorks and imported into the virtual scene of the simulator using Extensible 3D (X3D). X3D is an ISO standard used to build 3D Web-based environments. In order to visualize the graphical content of X3D online, a Web browser needs a special plug-in which is freely available for public, non-commercial use. The graphical user interface of the simulator emulates a gaming scenario featuring HTML controls, a virtual 3D scene, and a controls panel with a timer and scoring scheme. The module was implemented as team projects in ENGR1100 in Spring 2009 and Fall 2009. The projects consisted of 4 phases, which were based on the engineering design process also introduced in this course. Further details including assessment results based on student surveys and performance are discussed in the paper.
Design of a Dust Collector Performance Experiment: An Extracurricular Student Project

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Western Kentucky University / Western Kentucky University / Western Kentucky University

Extended Abstract

Recently at Western Kentucky University’s mechanical engineering thermal-fluids laboratory, a student worker, the author of the paper, was given the opportunity to design, build, and test (DBT) a dust collector performance test bed. The development of this test bed was inspired by an article in Wood Magazine, which described a method for testing the performance of various portable dust collectors.

The test bed developed is being used for instructional purposes in one laboratory course in the WKU Mechanical Engineering (ME) program. Currently, the test bed is used in the program’s Engineering Experimentation and Instrumentation course as a dust collector performance experiment. In this course, the experiment provides students experience in method of measurement, selection of instrumentation, errors in and the proper use of pressure and air flow velocity measurements, and fan selection. Moreover, the test bed is capable of being used in a variety of other applications making it possible to be used in other laboratory courses in the future.

The test bed incorporates a common portable wood shop dust collector with a duct system consisting of round metal duct, plastic flexible hose, and various duct transitions. In the experiment currently being used, air flow rates and static pressures are measured in the duct for several different duct configurations, or operating points. These operating points are then used to plot the dust collector’s fan curve and compare it to the manufacturer’s listed performance characteristics.

This paper focuses on the DBT process of the test bed and the development of the experiment. Moreover, an assessment of the project is provided through an analysis of the student worker’s learning experiences during the execution of this extracurricular project inclusive of both technical and project management aspects.
Whatever Happened to Product Realization? Will Technology Programs Succeed Where Engineering Programs Have Failed?

John T. Berry, Taylan Altan, & John E. Wyatt

ABSTRACT - During November 1969 The Society of Manufacturing Engineers (SME) held a Forum on Manufacturing Education, at the General Motors Institute (GMI), (now Kettering University), in Flint Michigan. The need for ‘formally trained manufacturing engineers’ had been revealed in an SME sponsored study conducted by Arthur D. Little, Inc. The meeting convened by SME, involved six (6) distinguished speakers from industry, including such organizations as Ford Motor Co, IBM, Whirlpool, Diebold, Caterpillar, and Western Electric, and six (6) speakers from academia (Boston University, The University of Illinois at Chicago Circle, The University of Bridgeport, CT, Utah State University, and The University of Vermont). Each of these institutions possessed curricula designated Manufacturing Engineering. At that time (1969) they were the only universities in the US with curricula so designated.
A Proposed Learner-Centered Mechatronics Engineering Instructional Program

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Extended Abstract
This paper examines the need and requirements for a mechatronics degree program. The results of a survey of the few existing programs in this field are provided. Then, using a case study example for Virginia Tech, a proposed mechatronics curriculum based on a learner-centered paradigm is described. The curriculum combines existing courses in mechanical, electrical, and computer engineering with new, hands-on courses to provide students with a chance to practice and explore the subject matter in ways consistent with the demands of both industry and accreditation. This program, if implemented, could provide a university with a unique offering to attract top students by better preparing them for the types of problems they will encounter in the modern world.
Using Camtasia Relay on a Tablet PC to Record Lectures in the Classroom: Experiences of a First-Time User

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Extended Abstract

Given the continuing increase in online education options for students, many universities are seeking methods which would allow faculty to quickly and easily create online versions of current courses. Using Camtasia Relay in conjunction with a Tablet PC allows for a simple, two-step process for recording lectures in the classroom and provides an excellent combination of audio and video information without the need for video editing skills. These recorded classes can be used in several different ways, including as an asynchronous course offering.

While the use of these tools may alleviate the need for advanced video editing skills, their use does require instructors to make adjustments to their teaching methods and styles. While these adjustments vary in terms of difficulty and additional work for the faculty, they ultimately affect the quality of the finished product. As a first time user of this technology, Dr. Click is experiencing firsthand the issues and challenges presented. To date, some of the issues encountered include: noise both inside and outside of the classroom, appropriate volume levels when interacting with students, unexpected noise associated with movements of the instructor, required changes in gestures used to emphasize points, and both the quality and availability of electronic resources.

The paper and presentation begin with a brief overview of the tools needed to use Camtasia Relay for recording lectures. The bulk of the paper is then dedicated to the discussion of issues which arose during a semester of use, including some pre-conceptions that were false, some issues which were overcome during the semester, and some issues for which an acceptable solution has not been found. The presentation will also include a demonstration of Camtasia Relay with the tools discussed in the paper.
Learning Statics: A Cognitive Approach

Chris Venters and Lisa McNair

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Extended Abstract

The deficiency in conceptual understanding among students in statics courses has been well-documented. Recently, much progress has been made in identifying, quantifying, and treating the misconceptions that students bring with them to the course, and this research provides valuable insights to professors teaching these concepts. It is argued here, however, that also needed are better ways of organizing and delivering course content in order to promote the transfer of material to new contexts as well as the development of metacognitive abilities in students. Through the analysis of survey and interview data collected from statics students during the spring 2009 semester at a large public technical university, this pilot study identifies further opportunities for research aimed at promoting deeper understanding of course concepts in statics. The results show that even after course material was presented, practiced in homework problems, and tested in an exam, some students struggled with transfer of these concepts to new situations and lacked the metacognitive ability to successfully monitor their progress when solving problems. While students in general were confident in their ability to perform the math required for the course efficiently, those interviewed showed difficulty describing course concepts and the interrelations among them. Moreover, the individual ways that the interviewed students approached learning in this course seemed to hint at potential explanations for differences in their performance. While the results of this pilot study are not sufficient to prove any such relationship between learning approaches and performance, they do provide indication of potentially fruitful areas to explore further. Additionally, they may highlight the need for a cognitive approach to course design and administration with activities that promote meaningful connection among course material rather than solely mathematical proficiency. Thus, this paper proposes curriculum enhancement through application of modern educational research, specifically outlining some possible activities that align with cognitive theories of conceptual learning.
Discovering Patterns in Student Activity on Programming Assignments

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Extended Abstract

In our introductory computer programming courses, students submit their code to an automated grading system for assessment, and they are allowed to make an unlimited number of attempts before the assignment is closed. This sequence of submissions can be viewed as time series data where each attempt gives rise to one or more data points, or events, that describe either an action that the student has taken (such as changing their code size or test coverage) or a result of those actions (such as a change in score). By giving students unlimited attempts and encouraging them to submit frequently by providing them with instant in-depth feedback about problems found in their code, we have accumulated a wealth of data to analyze.

Frequent episode mining is a data mining technique that lets us discover frequently occurring patterns in time series data. We apply this technique at three different scales with data generated during one of our courses in order to better understand the behaviors of our students during the time that they work on a programming assignment. First, we look for patterns within 24-hour periods to see how student activity during the initial days of an assignment differs from activity that occurs very close to, or after, the due date. Second, we examine student activity across an entire assignment to identify patterns that result in high scores that are distinct from patterns that result in low scores. Last, we compare the patterns that we find on the first and last assignments in order to determine if any changes in behavior occur that would indicate an improvement in programming habits as students move through the course. This paper presents an examination of the trends that we discovered in our student data.
CoPractice: An Adaptive and Versatile Practice Tool

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Abstract

Chapter 2 Deliberately practicing learning material helps students rehearse and refine their knowledge and skills. Instructional technologies can consequently support students' learning through electronic practice environments. Specifically, adaptive technologies such as intelligent tutoring systems (ITS) provide customized "tutor" feedback based on students' actions while they practice. This feedback – catered to the student's needs – is essential in helping students learn from their mistakes and make effective use of practice time. However, such intelligent systems can require extensive development specific to a subject or problem type and may be impractical to extend with new material or to apply to different subject areas. Consequently, learner adaptability can come at the detriment of versatility in practice systems.

Chapter 3 We designed and developed CoPractice as a new kind of practice environment that leverages community-driven content to establish a versatile system unrestricted by subject. CoPractice evaluates questions for their difficulty and discrimination based on usage data. It then decides on the most appropriate question for a student at any given time based on Item-Response Theory. Likewise, CoPractice evaluates the "tutor" feedback messages for their helpfulness and then adaptively chooses the most appropriate feedback depending on the circumstances of a student's struggles. In addition, it also takes advantage of social networking and positive reinforcement to encourage students to both practice by themselves and to contribute questions and feedback for other students.

Chapter 4 This paper describes CoPractice's design, data measurements, and purpose. It illustrates how CoPractice persistently refines its adaptability and organically evolves to promote better questions and feedback while suppressing lesser ones. As a result, the paper details how CoPractice maintains adaptive student interaction without sacrificing its versatility.
Design and Build: Teaching Cognitive Skills through Tool Use

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Extended Abstract

The six-semester 10-credit design and build studio sequence in the School of Engineering at James Madison University focuses on product and process design. Instruction in the design sequence is developmental (using Bloom’s Taxonomy) and focuses on four contexts in sustainability: environmental, social, technical, and economic. Throughout the design program, in addition to design instruction and practice, students receive group and individual instruction in the use of machine tools (e.g., drill press, band saw, hand tools, sanders, lathe, etc.) in projects that develop and support critical thinking and cognitive process development.

Our approach to teaching the design process includes significant instruction and practice in the intentional and directed cognitive processes and habits that foster effective thinking. This approach includes projects that require students to physically construct their designs as part of the design iteration process. Our assertion is that critical thinking in combination with hands-on project experience inspires better design.

The principle objective of this effort is to improve engineering students’ thinking skills and problem solving abilities (as well as tool use skills) through brief design projects that target and enhance specific cognitive processes employed in the construction process experience (e.g., visual imagery and spatial awareness, prediction, concentration, shape / form / size / proportion, and reasoning in conceptual thought). This paper and presentation address the tool training required to prepare students to function in the studio, the projects we assigned to target and develop specific cognitive processes, and relevant results of our first survey of freshman engineering students following the first design and build module.

This effort is funded by NSF IEECI Grant #0933948.
Introducing High School Girls To PC Board Assembly

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Extended Abstract

The ultimate goal in this title was to introduce high school girls to the importance of electronics and how it affects our daily lives. This paper will highlight the factors and events leading up to the summer of 2009 and the author’s inclusion of electronics into the girls’ training sessions.

In 2007, two professors in the Engineering Technology Department at the Herff College of Engineering, University of Memphis, introduced a new grant-funded summer outreach program for high school girls who were academically qualified to participate. ‘Girls in Manufacturing’ (GiM) seeks to introduce high school girls to some of the technological processes used in engineering and in industry today. The participants initially were exposed to and participated in six major elements including Bio Diesel, AutoCAD, CNC, Welding, Robotics, and field trips to the respective local sponsor companies. The weekly program is held twice each June and is co-sponsored by the Cargill, Carrier, and Cummins Corporations.

As GiM’s third year approached and noting that basic electronics was not part of the program, this author suggested the addition of some electronics training into the program to expand the girls’ knowledge to include basic electronics and its importance to technology and industry. A proposal for a mini-grant was written and submitted to the Electrical and Computer Engineering Technology Department Heads Association (ECETDHA) in the fall of 2008. The proposal was one of only three mini-grants selected and subsequently awarded for funding by the association that year. The grant was used for the purchase of electronic kits and soldering irons.

This paper will discuss the basics of the initial program, the addition of basic electronics theory, component applications, and pc board assembly procedures to the GiM program and the benefits gained for the GiM participants and the subsequent improvement of the overall program.

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Abstract

STEM (Science, Technology, Engineering and Mathematics) education for the future does not only include textbook learning but also relevant experience gained from participating on activities such as high school after-school robotics competition. A company sponsored robotics club in partnership with a local teaching association works together to develop training material for teachers engaged in coaching after-school robotics competition teams. The training material developed in collaboration with industry and educational institutions can be delivered either online at a self-paced mode or as part of teacher training in chunks that can be delivered independently covering topics such as how to identify good industry mentors for the teams to technical topics such as how the engineering process in the industry might differ from engineering process taught in the middle school, high school or at a higher learning institution. The creation of teaching modules includes a variety of media including video clips of those involved in robotics competition addressing different topics addressed on a given module. The key to education in 2016 is the delivery of content that is pulled instead of pushed to those that consume new learning materials. In the fast pace of the internet age where ideas are now a commodity, professionals need to be engaged real-time with pre-engineering students that are gaining tremendously valuable engineering experience before going to a higher learning institution by participation on robotics competition. Professionals that want to give back to the community need to have the relevant skills and authentic experience necessary to be able to effectively mentor student led robotics team. This experience can be obtained by participating in an experiential learning community where individuals of different background, experiences and skill levels work together toward a common goal such as building a demo robot with the support of their company. An experiential learning community allows the formation of a “team” that has a goal and purpose while having a semi-flexible structure allowing a collegiate environment to thrive. The success of an experiential learning community hinges on the ability of companies to develop the organization engineering mentoring skills thru training and providing opportunities for the employees to engage with students thru after-school programs such as after-school robotics competitions. Robotics competitions geared toward high school and middle school students enable not only the engagement of mentors from industry but also mentors from higher learning institutions that wish to either be engaged for the first time or give back to the community while continuing to develop their engineering and leadership skills. Experiential learning can be deployed by using video clip, categorized in 3 different types: demonstration videos, learning community status videos and learning modules video. Demonstration videos are videos that show the outcome of the learning such as working robots to individuals within an organization that are thinking in becoming involved, while learning community status videos shows individuals already engaged such as professionals, faculty, teams leaders describing their community and the engagement of given community. The last category of video is the learning module videos that teach a technical or a soft skill to those new in the learning community that just have become engaged in the learning process.
Engaging Current and Future Engineering Students Using PBS Design Squad

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Extended Abstract

It is widely known that engineers serve humankind. It is also widely professed that the best way to learn is by doing. While the altruistic nature of the engineering profession piques the interest of many students, many others are turned away because of their aversions to math and science, their negative perceptions of engineers, and/or poor instructional techniques. Further, it is no surprise that many students who declare themselves as engineering majors lose interest because classes often fail to emphasize what engineers actually do and how they actually impact society. As a result, there is concern that the United States is facing the dual challenge of a shortage of practicing engineers and lack of competitiveness in engineering in the global market. Therefore, as we define the educational needs of the engineer of 2020, service-learning should be a part of the discussion because of its potential to impact college students studying engineering and pre-college students exploring possible career paths.

This paper describes one approach implemented in a partnership between the Elon University Dual Degree Engineering Program and a nearby public elementary school. Second semester freshman engineering majors mentored teams of fourth and fifth grade students and facilitated five design challenges throughout the semester. The design challenges are published on the companion website for the television series Design Squad, a PBS reality show featuring teams of young people working through engineering design challenges. This paper discusses the development of this project and its execution, assessment, and outcomes during its inaugural year. The first-year engineering students cited increased engagement in the course, deepened curricular knowledge, more interest in civic engagement, improved communication skills, enhanced team work skills, and personal growth in areas such as leadership and preparedness among the benefits of participating in a project of this nature. The elementary students demonstrated increased awareness of the engineering profession and an ability to engage in engineering design. There is also some evidence that more long term benefits of improved learning and achievement in science and mathematics and interest in pursuing engineering as a career may occur. National organizations and numerous researchers have conducted studies which show that the aforementioned areas must be addressed in order to tackle the greater issues of recruitment and retention.
Techfacturing: A Summer Day Camp Designed to Promote STEM Interest in Middle School Students through Exposure to Local Manufacturing Facilities

Robert J. Prins, Sarah MacDonald, James Leech, Jonathan Brumfield, Michael Ellis, Lester Smith, and James Shaeffer

James Madison University School of Engineering/ James Madison University Outreach and Engagement/ Blue Ridge Community College Manufacturing Engineering Technology/ Blue Ridge Community College Mechanical Engineering/ James Madison University Outreach and Engagement/ Blue Ridge Community College Tech Prep/ James Madison University Outreach and Engagement

Extended Abstract

“Techfacturing” is the name given to a three day summer day-camp for middle school students that was implemented in summer 2009. The goal of Techfacturing is to encourage local students to pursue Science, Technology, Engineering, and Math (STEM) based careers in order to support the talent pool for industry in the Shenandoah Valley. The camp was developed by a team of administrators and faculty members at Blue Ridge Community College (BRCC) and James Madison University (JMU). Techfacturing participants are introduced to local electronics, medical supply, and snack manufacturing facilities as well as college campuses. The day-camp is aimed at middle school students with the intent of influencing their academic decisions as they enter high school.

Camp activities include small-group projects for the participants as well as exposure to local manufacturing plants through tours. College students participate extensively as mentors, minders, and small-group facilitators. This paper describes the camp activities and organization in enough detail to facilitate transfer to other outreach attempts. Our inaugural event was effective in providing middle school students with a quality experience as well as generating ideas for improvement. We measured our effectiveness in three ways: response of participating students to a survey, response of parents to a survey, and observations made by camp staff. The results of these measurements are shared and discussed along with significant lessons learned and our planned next steps as well as observations by the camp developers.

The evaluations from parents and students, as well as the observations of camp developers and staff, together contribute to the development team’s understanding of the success of programs of this nature. Overall, Techfacturing was a great success, and parents and students were pleased with the experience. Many of the students grasped the connection between their morning activities and the physical experience of touring the plants and seeing manufacturing in action, and parents appreciated these connections as well. Faculty at both institutions had the chance to build relationships with their counterparts, which creates valuable future collaboration opportunities.
Introducing motor and gear calculations in a freshman-level design course

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Extended Abstract

Mercer University’s School of Engineering introduces its freshman-level students to an engineering design process that includes design selection, construction, and testing via its Introduction to Engineering Design course (EGR 107). The course content includes a final design competition in which student teams challenge each other in head-to-head vehicle based contests. These contests have been structured such that high speed, low forward force vehicles and low speed, high forward force vehicles both have the ability to win. In general, this involves establishing a competition time limit, typically 60 to 120 seconds, and having the vehicles running directly at each other in a closed course such that a head on collision is inevitable. The winner is then the vehicle that is closest to the opponent’s starting line when the competition time limit expires. Each design team is provided with a K’Nex® based project kit that includes rods and connectors, wheels and tires, a DC motor (K’Nex® model #92880), four different gears (14, 34, 58, and 82 teeth), a wound spring motor, a mousetrap, a variety of rubberbands (#32, #64, #107, and #117B), twist ties, music wire, and string as well as some miscellaneous parts.

A key and unique component of this course is that freshman-level students are provided with simplified technical tools to enable them to predict design performance. Specifically, they are provided with the motor curve for the DC motor as well as basic equations that can be used to predict the vehicle’s maximum speed and forward force based on the gear train and wheels used. The students are required to conduct experiments to verify their calculations. Testing kits that include a stopwatch, tape measure, and spring scales are made available to the students so that they can measure vehicle speed as well as forward force generated.

Eight different vehicles were constructed for this presentation. In five of the vehicles, the rear wheels were driven directly by the DC motor while in the remaining three vehicles, a two gear drive train was used between the motor and the rear wheels. In the five direct drive vehicles, the size of the rear wheels was varied from 4.45 to 12.7 cm. In the vehicles with a drive train, the rear wheels were 8.89 cm in diameter. The drive trains evaluated were motor → 14 tooth gear → 34 tooth gear → rear wheels, motor → 34 tooth gear → 34 tooth gear → rear wheels, and motor → 34 tooth gear → 14 tooth gear → rear wheels. Speeds and forward forces for these configurations ranged from 5.2 to 25.0 meters/min and 1.62 to 9.57 N, respectively.

This presentation will include the motor curve, calculation process, example calculations, and testing results.
Enhancements to Software Defined Radio Design Engineering Education

Carl B. Dietrich, Frank E. Kragh*, S.M. Shajedul Hasan, Jeffrey H. Reed, Donna L. Miller*, and Stephen H. Edwards

Virginia Tech, Blacksburg, VA/* Naval Postgraduate School, Monterey, CA

Extended Abstract

Software defined radio (SDR) combines aspects of computer science with communications, computer, software, and systems engineering. SDR instruction 1) integrates students' prior knowledge of enabling technologies and disciplines; 2) diversifies students' skill sets to enhance their ability to advance SDR and other multidisciplinary areas of engineering.; and 3) meets a need for engineers familiar with SDR and related technologies. SDR courses must both survey and integrate relevant topics, and introduce students to challenges that are characteristic of SDR and typical of multidisciplinary engineering. This paper describes implementation and outcomes of enhancements to SDR graduate courses at the Naval Postgraduate School and at Virginia Tech. Recent modifications include development of hands on laboratory exercises and their increasing integration into the courses, use of block oriented modeling software and open source SDR software and rapid prototyping tools to bridge the gap from theory to prototyping of SDR waveform applications, and integration of industry and government examples and case studies. Course structure and recently introduced approaches are described and outcomes characterized based on observation and numerical and qualitative student reporting. Finally, plans for refining and synthesizing reported approaches and incorporating further enhancements are described.

Software Defined Radio (SDR) design is important in the field of electrical engineering in both the civilian sector and military sectors, as is evidenced by software defined cellular basestations and the multi-billion dollar Joint Tactical Radio System (JTRS) Program. There exists a largely unmet demand for communications engineers with SDR expertise. Thus, there is a role for engineering universities to enhance curricula to meet that demand. This paper describes recent enhancements to the VT and NPS SDR courses described in a 2008 ASEE conference paper. These enhancements include restructuring the course to enable more hands-on laboratory exercises and project work, in-depth coverage of synchronization methods and discrete-time approaches to radio design, new simulation exercises, additional laboratory exercises, substantial new features to the software design tools, and refinements to the laboratories. These courses are training our students to meet the demand for this expertise in industry and government.
Implementation and Evaluation of Laboratory/Tutorial Exercises for Software Defined Radio Education


Virginia Tech/*Naval Postgraduate School /**West Virginia University

Extended Abstract

A Software defined radio (SDR) is a radio where most of the functionality including modulation, demodulation, and forward error correction coding is implemented in reprogrammable hardware components. SDRs are very attractive when it is desired that the radio be multimode, upgradable by software update, or otherwise flexible. SDRs are evolving technology with substantial investment from the American military and the mobile phone industry. This has generated a substantial demand for communications engineers with expertise in SDR design.

Several American universities have introduced SDR into their engineering curricula, partially to respond to industry demand and partially because SDR design is an excellent example of modern multidisciplinary design challenges that is well suited to academic study. Virginia Tech (VT) and the Naval Postgraduate School (NPS) each include a course in SDR design in their graduate electrical engineering curriculum. These courses include lecture and laboratory portions. The laboratory portion is particularly novel and includes a sequence of laboratory exercises and projects that build upon one another to develop expertise in SDR design. These laboratory exercises have been used by both VT and the NPS for the courses as well as for several short courses at conferences. These laboratory exercises are the subject of this paper.

Retrospective pretest designs have proven useful in evaluating program outcomes and assessing the outcomes of short term educational interventions. In the Virginia Tech graduate student sample, such a design was used to assess how each lab affected student understanding. Students were asked to rate their understanding of course topics on a Likert-type scale of 1-5, with ‘1’ signifying the lowest rank and ‘5’ the highest. These ratings pertained to understanding both before and after each lab. Median self-reported understanding was higher after the labs than before in all cases, and in two-thirds of the cases, the increase in understanding was found to be statistically significant. Statistical significance was defined at a criterion alpha level of .05.

Students completing the SDR course at the Naval Postgraduate School are asked to rate the laboratory exercises as part of the course evaluation. The overall rating for the labs for the Summer 2009 course, the most recent, was 4.33 on a scale of 1 to 5, with 5 being the best rating.

SDR design is multidisciplinary and thus challenging to teach and challenging to learn, and hands-on experience is very useful. This paper describes a well-developed sequence of increasingly sophisticated design experiments that provides this experience for students at VT, NPS, and short courses at several technical conferences. The laboratory exercises and all necessary software is available for free download. The authors encourage faculty members and others to consider using these exercises to help satisfy their SDR design education needs.
Economical Classroom Laboratories for Material Science

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Extended Abstract

Material Science is most economically taught between four walls with a chalkboard but the results are questionable. The most effective approach includes a laboratory experience using dedicated laboratory equipment and space. This paper presents an intermediate approach with the details of five laboratory exercises performed in the front of the classroom. The first laboratory is used to teach or refresh laboratory writing skills. Students determine the stress/pressure for a common material. The lab helps them to distinguish between force and stress. The second lab is a simple physics demonstration for determining the coefficient of thermal expansion. The lab also begins to explain how a coefficient relates two properties. Lab three allows students to learn about spring constants and how they relate to the elastic modulus. The fourth laboratory demonstrates beam stress and strength; and the last lab measures beam deflection. The activities demonstrate practical material properties and teach laboratory writing skills. The demonstration labs involve the students and are specifically designed to help students grasp the mathematics used to characterize materials. A brief history of the laboratory development is included along with a summary of the pedagogical results to date.
A Low Cost Conveyor System for Teaching Automation to Engineering Technology Students

Aaron K. Ball and Johnson S. Busick

Western Carolina University

Extended Abstract

With many institutions of higher education experiencing revenue shortfalls and budget cuts, alternative approaches for implementing engineering applications for laboratory instruction have been undertaken at Western Carolina University. One such approach involved graduate directed projects specifically designed, fabricated, programmed, and tested to support an undergraduate automation course in Engineering Technology. This paper will focus on how an automated conveyor system can be used to supplement Engineering Technology programs. As a result of a graduate level directed project, a new conveyor system was developed including the integration a Siemens Programmable Logic Controller (PLC), laser sensors, and a National Instruments Data Acquisition and Control (DAQ) module. Further, the unit was developed for supporting laboratory instruction in engineering technology programs. Using LabView™ for monitoring and a PLC for control, a relative low cost but effective conveyor system was developed at Western Carolina University. This paper will present a logical approach to developing such a system and describe how applications have been integrated into the curricula of the Engineering Technology Program at Western Carolina University. Emphasis will be placed on system design, fabrication and control methods. Further, how the project was integrated into a valuable learning experience for both graduate and undergraduate students will be presented. Educational merit will be described relative to respective educational levels.

Keywords: Engineering Technology, graduate directed projects, automation, undergraduate laboratory instruction.
LabVIEW-based Laboratory for Electronics Engineering Technology Program

Zhaoxian Zhou

The University of Southern Mississippi

Extended Abstract

Distance learning is developing rapidly in recent years due to the development of technology and instructional systems. With the recent budget limits and decreasing in enrollment, distance learning is even more critical. Distance learning in technology programs is difficult to implement because almost all technology degrees require substantial hands-on skills, which are traditionally obtained in laboratory environments. The requirement for hardware laboratories in turn restricts greatly distance learning experience. The Electronics Engineering Technology program in the University of Southern Mississippi is in the process of implementing a project which will provide distance learning through LabVIEW platform. Senior undergraduate students and graduate students took part in developing learning environment; therefore, the project gave them opportunities to develop skills in programming in virtual instrumentation. Users who were usually lower-level undergraduate students improved their experimental skills. This project also aims to enhance the interest in electronics and computer engineering and technology of the high school students in southern Mississippi.

In the paper, the author introduced practice of implementing LabVIEW-based simulation of technical experiments. The purpose of the study is to investigate the perceptions of virtual experiments from students’ point of view. Within two semester’s period, students and instructors have developed virtual as well as traditional experiments. Student survey results are given after they have carried out both experiments. The survey showed that virtual experiments are helpful in both strengthening old and gaining new knowledge. However, traditional laboratories are still irreplaceable. Even for online degrees, students still prefer traditional face-to-face lab environments. There is still a long way to go if traditional laboratories are to be substituted by virtual laboratories. Virtual laboratories, especially those that aim to a large audience across multi-institutions, should be designed as student-oriented. The author agrees that institutional collaborations and student involvement in the design process are necessary.
Practice of Increasing Enrollment and Retention of Electronics Engineering Technology Program

Zhaoxian Zhou

The University of Southern Mississippi

Extended Abstract

The student enrollment in engineering technology programs overall has experienced constant decline over decades. The electronics engineering technology program in the University of Southern Mississippi was previously a key part of one of the largest engineering technology programs in the country, with an undergraduate student body of about 140 at its prime. The enrollment and retention rates have been decreasing during the last decade. Many reasons contribute to the trend, one of which is the student misperception on engineering technology.

The University as well as the EET program analyzed the major issues that affected the enrolment and retention, and proposed plans to improve the situation. Methods that have been used include closer connection with industry, modification of core curriculum structure, introduction of emerging technologies, improved student advisement, sponsored programs to attract perspective students, summer camp activities, high school visits, better connections with students during school breaks, and more. Along with the strategies at the university level, the departmental plan works well. The program enrollment increases while the university enrollment breaks a record. This presentation introduces the various methods that have been adopted at the University level, the Department level, and the program level. The presentation also analyzes the effectiveness of the methods; compares advantages and disadvantages, and discusses plans that may be used in the future.
Industry Partnerships at Western Carolina University: Live Projects that Work

William L. McDaniel and Aaron K. Ball

Western Carolina University

Extended Abstract

Western Carolina University is committed to provide opportunities for students to engage in real-world projects benefitting both students and external constituencies. WCU has several mechanisms in place that allow collaboration between the university and industry. The university developed a Quality Enhancement Plan (QEP) that encourages students to create connections between what they learn inside the classroom and the outside world. In addition, Western Carolina has adopted the Boyer model for engaged teaching. The Boyer model supports the creation of a learning environment (inside and outside the classroom) that incorporates discovery, integration, analysis and application, knowledge transmission and transformation, and the understanding of real world issues. Further, Western Carolina University utilizes the Stewards of Place philosophy of aiding state and local entities in addressing issues affecting the common good. Finally, the implementation of Project Based Learning allows students to function in realistic environments similar to those they will encounter in the workforce. In the Engineering Technology department, it has been rewarding for the university to follow the same philosophy of collaboration that has been in place in our department for many years.

One specific vehicle for student engagement has been the Integrated Systems Project class. The class, essentially a senior capstone class, is focused on an applied project that integrates student competencies gained over their entire WCU experience. Students have been able to secure projects with many regional and national industries, including Leviton, Penske Racing, CommScope, Volvo, Continental Automotive and Corning Cable Systems. This paper will present the approach taken to implement the projects and specific successes that have been realized through the class. Educational merit and future plans for further implementation will also be discussed.
Methods for Increasing Enrollment in a Telecommunications Engineering Technology Program

Tom Fallon

Southern Polytechnic State University

Extended Abstract

After an initial surge in enrollment accompanied by a high retention rate, the associated numbers of the 4-year, multidisciplinary Telecommunication Engineering Technology (TCET) degree program, which is part of the Electrical and Computer Engineering (ECET) department, at Southern Polytechnic State University began to decline. Impact of a newer and similar degree, initial heavy market decline in the wake of 9/11, the dot-com bubble, and uncertainty in key degree-related terms were some of the important factors suspected of having combined to cause the enrollment decline.

After having established an online collaboration site we began to meet regularly to discuss the various aforementioned causes and specific methods by which they could be remedied. Research showed that growth trends in various areas of the telecommunications industry provided a potentially positive future for the TCET program. This research spurred discussion about marketing the program and creating a better interface to the industry. Another investigation revealed a misunderstanding of the term “telecommunications,” which likely contributed to confusion among prospective TCET students. We decided that a clear definition of “telecommunications” and how it differs from the term “information technology” should be introduced into marketing material and properly conveyed to key stakeholders including faculty, staff, and students.

We recognize the need to improve our recruitment efforts among students who have either completed or are still enrolled in 2-year technical college programs, and who might be seeking a baccalaureate degree in the telecommunications field. As part of an outreach strategy to improve enrollment we are developing a plan to meet with recruitment officers and academic administrators of 2-years programs located at increasing geographical radii from our campus over a specified timeline of 5 years. In addition to the 2-year programs component, our strategy involves the recruitment of students interested in telecommunications, who are attending 4-year colleges at more remote campuses for whom a daily commute is not practical. In order to reach out to and serve both categories of students we have begun discussions on adapting certain TCET courses to an online format, and have begun to identify the technical challenges and solutions associated with such adaptations.

Although several excellent references exist which highlight the various means by which retention and enrollment of college programs can be improved, we focus on only a few of the key enrollment-related activities that the TCET committee is pursuing. Enrollment data have shown apparent stabilization and, perhaps, a small increase in enrollment starting this past fall term.
SPEED – An ASEE Initiative for A Nationally Recognized Development Program for Engineering Educators

D. Schaefer, D.P. Visco, Jr., T.T. Utschig, J.P. Mohsen, N.L. Fortenberry, M. Prince, C. Finelli

Abstract – For the past century, many organizations have published visions of what the technological needs will be in the future for the United States and how the engineering profession might change to meet those needs. There has also been a long-standing call to strengthen engineering and technology educators’ capabilities and preparation to perform the task of educating students. A recent response to this call is SPEED: Strengthening the Performance of Engineering and Engineering Technology Educators across the Disciplines. SPEED is a concept for a nationally recognized professional development program supported by ASEE for engineering and engineering technology educators. Here, the authors describe the rationale behind SPEED, review related international activities, discuss opportunities and challenges for such programs in the United States, and explain SPEED’s potential.

The central goal of the ASEE SPEED program is to positively and significantly impact the quality of engineering education across all engineering and engineering technology disciplines through faculty development. Around the world, several models for programs to support professional qualification, development and/or recognition for those teaching in Higher Education are known and have been analyzed. Lessons learned from these models have been considered in conjunction with opportunities and challenges within the U.S. As a result we now present the ASEE SPEED program designed to provide the engineering and engineering technology education community a set of tools for development of instructional expertise; a community consisting of program leaders, providers, participants, and informed stakeholders; a program management infrastructure supported through ASEE including web, print, and institutional knowledge; and a broad national visibility. Initial SPEED project development activities include identifying the items comprising the core competencies and outcomes of faculty for three separate levels of the SPEED program, conducting focus groups to solicit feedback about the SPEED Level 1 program, designing a SPEED Level 1 program based on the feedback, and engaging various constituencies in the process.

The authors explicitly wish to use this paper as a platform to initiate a dialogue within ASEE about the SPEED concept.
Self-efficacy in female and male undergraduate engineering students: Comparisons among four institutions

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Virginia Polytechnic Institute & State University / Northeastern University / Northeastern University / Rochester Institute of Technology / University of Wyoming

Extended Abstract

Researchers from four universities with strong engineering colleges collaborated on a project that seeks to isolate those factors and experiences that contribute most to the development of positive self-efficacy beliefs and, ultimately, to the increased retention of women in undergraduate engineering majors. A survey was developed to administer to students at each institution during their sophomore, junior, and senior years. Two of the engineering colleges require participation in cooperative education programs for fulfillment of the program of study and two do not. We suggest that a work experience could result in an increase in work self-efficacy that would bolster academic and career self-efficacy. Data analyses show similarities and differences between and among female and male students at these institutions with regard to their current self-efficacy levels (academic, work, and career), amount of support provided for female students, and how likely females are to take advantage of services provided.
Elon’s Enhanced Engineering Dual Degree Program

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Extended Abstract

Elon University has developed a unique engineering dual degree program (3 plus 2) that produces well rounded engineers with a depth in the sciences and breadth in engineering. It is an enhanced and improved adaptation of engineering dual degree programs that most liberal arts colleges administer. The vast majority of these programs are housed in a physics department, are directed by a physicist, have no engineering faculty and have no engineering coursework given during the three years at this college. Elon University perceives these as weaknesses and has created its program with the intent to avoid and/or correct them. Elon’s system stands in sharp contrast to these other programs and produces students well prepared for the transition to the affiliate engineering school and then onward to a promising engineering career.

This paper describes the typical engineering dual degree program. It then presents the contrasting program as conducted at Elon University were a engineering student is able to receive their engineering degree and also a liberal arts degree in a supportive science or math, all within five years. Highlights of Elon’s program includes 1) the choice of six liberal arts options, 2) contracted affiliations with nine excellent engineering schools, and 3) engineering professors on Elon’s campus to not only teach engineering courses (students are able to take at least one ever fall and spring semesters), but also to mentor and advise the engineering students.

This paper delineates the engineering foundational courses required and course sequencing for the three year component on the liberal arts campus. A section is also reserved to describe the introductory course entitled “Challenges in Engineering” that all freshmen take.

Engineers are problem solvers necessary for the advancement of society. With the infrastructure failing, environments stressed and population growing in number and demands, the need for more and talented engineers is clear. The Elon program enables the student to realistically work toward a degree in engineering while also getting a science/math based liberal arts degree. This is accomplished by having engineering faculty at the liberal arts college teaching engineering courses. When a student transfers to the engineering institution he or she is essentially an engineering junior, has a good understanding of what it is to be an engineering student and is well positioned to tackle their next two years of schooling. The adoption of a program such as Elon’s at other liberal arts colleges could help boaster the ranks of engineers in the United States with excellent, well rounded engineers.
Implementing a Peer Leadership Model in a Large Scale Peer Mentoring Program

Rosemary Patterson and [Tyler Aarons, Erin Crede, Kaitlyn Hines, Jean-Louis Bile, Jared Chelko, Ryan Hubbard, Fleur Gooden, Whitney Edmister, Dr. Bevelee Watford]

Virginia Tech

Extended Abstract

Retaining students in engineering and the sciences depends largely on the availability of resources for first-year students, and as a result, mentoring programs have evolved to guide and support new engineering students [Gattis et al.]. As traditional notions of mentoring have changed, it has been seen within higher education that undergraduates are more frequently used as peer mentors [Budge]. In the past, a peer mentoring program at a large research university on the east coast was led by one administrative faculty member. A major structural change to the program was made this year, to incorporate six peer leaders, all veteran mentors, who assumed many of the tasks of the original coordinator. Along with expanding leadership, other changes included shortening the program length from a full semester to ten weeks and utilizing Scholar, the university’s web-based course management system, to streamline the administration of the program.

A focus group comprised of both returning mentors and first-year mentors was created to assess the success of the change in leadership and overall program structure as well as provide recommendations for future improvement. To evaluate and analysis the data gathered from the focus group an open coding method was used [Strauss, Corbin]. The feedback gathered from this focus group led to the formation of six recommended changes for implementation. They included the formation of a more detailed agenda for weekly seminars, a buddy system for new mentors, improved organization and consistency in written feedback and small group discussions, and a reworking of the online course management site used in program facilitation. These changes, if implemented, will create a more structured program, improve networking and feedback, and foster an environment where the peer leaders can build a positive, professional relationship with the mentors.

The six peer leaders developed the questions asked during the focus group, reviewed the transcript of the focus group to supply these recommendations, and drafted this paper, all in an effort to learn the value of assessment and subsequently enhance the upcoming 2010 program.
Female Engineers at Mercer University; student recruitment, retention, and faculty involvement

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Extended Abstract

The goal of this paper is to report on the current status of female students and faculty in the School of Engineering at Mercer University. This study is a continuation of a previous paper entitled “Involvement of Women Engineers at Mercer University” that is published in the 2008 annual conference Proceedings of the American Society for Engineering Education Southeast Section. This paper is focused on (1) female student recruitment, retention, and admission data, and (2) the comparison of male and female freshmen student academic preparedness and its influence on students’ future educational success. From a female faculty perspective, we investigated recent departmental structural changes and its influence on student perception of the school of engineering and on the general learning and working atmosphere. The paper consists of statistical analysis of employment and enrollment data and information obtained from interviews and open discussions with students and faculty.

Although more than 35% of engineering Bachelor’s degrees are earned by women at Mercer, the problem of low enrollment and poor retention stays valid and unsettling. New studies show that low enrollment, not low retention, is resulting in the small numbers of female engineering students and graduates. Statistical data on SAT and GPA scores of Mercer University engineering students from 2003 to 2008 were evaluated. As the engineering student attrition occurs the SAT score average for the remaining engineering student group changes. Higher retention of female students is strongly visible albeit lower numbers and generally lower average SAT scores of continuing students. Average SAT scores for male students show a tendency to increase indicating that primarily the well-prepared male students are retained. However, female students tend to have higher GPA scores that their male peers. The grades appear to be the highest in both groups for the 4th year which is a year of graduation for more than 70% of all engineering students. As expected, GPA score is lower for “super-seniors” (fifth year students).

The authors investigated the general opinion of female engineering students and faculty through open-discussion interviews and a student survey. The survey contained twenty two questions on an agree/disagree Likert Scale and proved that both male and female students have similar perceptions on women-engineers and that having mostly male faculty does not influence their success rate. The recent election of two women faculty members as department chairs is another indication that the working environment at Mercer is positive for both professionals and students.
Usability in Virtual Reality Construction Scheduling Education

Tulio Sulbaran, Ph.D, Andrew Strelzoff, Ph.D., Jian Chen Ph.D

Abstract

The implementation of Virtual Reality to provide simulated hands-on to construction students have significant potential and therefore usability of Virtual Reality for various training and experiential learning tasks has been the subject of considerable recent research. However, very little direct measurement of the usability of Virtual Reality interfaces has been presented in the literature. This paper presents experimental design and early results of classroom Virtual Reality exercises intended to gauge ISO 9241 requirement compliance for a Virtual Reality Construction sequencing learning experience.
A Learning Community Approach To Development Of A Sustainable Energy Course

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**Extended Abstract**

The sustainable energy field is rapidly evolving and garners much attention in the media and thus among students, who recognize that renewable energy issues offer significant engineering challenges and opportunities for their careers. In response to student needs to better understand this field, we developed a special topics senior-level course entitled “Sustainable Energy Solutions for a Global Society” using a learning community approach that directly involved students in knowledge- and course-building. This was important due to the breadth and rapidly changing nature of this field and because we wanted to encourage students to develop skills for surveying and critically evaluating emerging technology. To date, the course has been offered and fully enrolled over three consecutive semesters. The course has evolved, but the learning community approach has been maintained and students continue to enjoy an active role in developing materials used in the course. This paper addresses the course objectives and topics, observations on the collaborative course content development process, and strategies used in fostering student ownership and participation.
Motivating Learning Performance in Collaborative Virtual Reality Environments

Tulio Sulbaran, Ph.D, Andrew Strelzoff, Ph.D.,

Abstract
Motivation has been identified as a key factor in promoting students' higher-order thinking skills. Students who are highly motivated excel at absorbing and applying new materials and concepts. Students with low levels of motivation learn very little even with compelling and well designed classroom exercises. How then to motivate students beyond the traditional application of grade pressure? Collaborative Virtual Reality Environments, in which the students’ avatars interact with each other and the objects in the environment, offers new possibilities for raising student motivation levels. This paper discusses the use of “Coexistence Competition” in which students share the same virtual workspace and can see and examine each others’ ongoing progress. This new technique not only increases student motivation but also allows students to learn from each other more readily. This paper provides a template for the setup of Coexistence Competition learning environment in OS-BEST, the open source Collaborative Virtual Reality Environment under development at The University of Southern Mississippi.
A Comedy of Errors: Teaching Oral Presentation Skills Using a Spectacularly Bad Presentation

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Extended Abstract

Oral presentation skills are viewed as one of the critical outcomes required for ABET accreditation of both Engineering and Computer Science programs, and many professional practitioners would credit good or excellent presentation skills as one factor in their personal success. When recently charged with teaching oral presentation skills to students in the University of Tennessee at Chattanooga's "Introduction to Design" freshman level-class, as well as to the senior-level Computer Engineering capstone design class, the professor could have used the most straightforward (and some would argue, most efficient) method: to simply give students a list of expectations and a rubric by which oral presentations would be judged. However, the author chose to demonstrate all that an oral presentation should not be by giving a spectacularly bad presentation including over forty errors, divided evenly between errors in the viewgraphs used for the presentation and errors in the physical presentation itself. The students were required to generate a list of all errors of both types, which were then discussed in class. As a homework assignment, the seniors were then required to generate the rules for a proper oral presentation. The students’ rules were combined into a single list, which was used to form the rubric for the students’ own presentations. The rules developed by the students were specific and detailed, and were consistent with the type of rules the author has given to students in the past in similar courses. At the end of the semester, the students still recalled a significant number of the errors in the presentation. When questioned, students who expressed a preference were roughly evenly divided as to whether the “spectacularly bad” presentation method was more effective than giving students a list of rules, but most felt that the presentation was certainly more fun than a list of rules; a conclusion with which the author heartily agrees.
A System of Individualized Homework Assignments in Core Mechanics Courses

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Extended Abstract

Does homework improve learning? Although convincing evidence answering this question is sparse, it is this instructor’s conclusion that homework is the most important factor to maximizing achievement of the learning outcomes provided it carries sufficient weight in the computation of the final grade and is challenging, individualized, promptly scored and returned to student for correction by student.

The author has developed a system of individualized homework assignments for 1st and 2nd year core mechanics courses that effectively compels students to invest heavily in out-of-class assignments by substantial weighting in the computation of the final grade and by a correction policy that incentivizes correction of errors by returning half of any lost points.

Observations reported include an increase in student preparation for in-class lecture evidenced by Q&A, an increase in student engagement evidenced by office visits and email, increase in student motivation to learn on their own as evidenced by the improvement of final scores through finding and correction of errors and perhaps an increase in learning suggested by the significant correlation of homework scores and exam scores. Moreover, the author reports that the system, once developed, surprisingly reduces the time consumed scoring and grading.

The paper describes the details of course delivery, preparations of individualized assignments, grading and correction policy. The paper also presents the author’s observations and results of informal student surveys.
An Introduction and Literature Review of Fuzzy Logic Applications for Robot Motion Planning

Mr. Paul Yanik, Dr. George Ford, Dr. William McDaniel

This paper reviews fuzzy logic applications for robot motion planning. A short literature review is provided and three applications of fuzzy logic are considered: navigation and obstacle avoidance of a robotic vehicle in a 2D environment; a multilink industrial robot manipulator; and a robotic vehicle in a 3D environment. Scenarios are compared for their assignment of fuzzy sets, inference (rule base format and size), defuzzification technique, and the effectiveness and limitations of algorithms.

Keywords: fuzzy logic, fuzzy logic applications, robot motion planning, trajectory planning
Measuring Achievement Goal Orientations of Freshman Engineering Students

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Extended Abstract

Numerous studies have shown that despite efforts to recruit and retain students within the engineering major, fewer students are entering engineering. Student engagement and motivation are central areas of concern in improving recruitment and retention of all students in engineering. Although examining such non-cognitive constructs has been noted as important, there is a paucity of research investigating non-cognitive constructs within engineering education. One such construct that may be related to student engagement and academic outcomes is achievement goal orientation, defined as “different ways of approaching, engaging in, and responding to achievement situations.” Not only are various achievement goals linked to better use of learning strategies, persistence, and help-seeking behaviors, but exploring the various achievement goal orientations of engineering students may be important for recruitment and retention. Five components of achievement goals have been theorized: (1) Mastery-Approach (MAP) – desire to learn deeply, (2) Performance-Approach (PAP) – desire to demonstrate knowledge, (3) Mastery-Avoidance (MAV) – desire to avoid losing skills, (4) Performance-Avoidance (PAV) – desire to avoid negative judgment, and (5) Work-Avoidance (WAV) – desire to avoid work. Mastery goals are associated with a number of positive learning strategies and attributes; for example, the belief that effort leads to success, a preference for challenging work, interest and positive attitudes toward learning, increased time on tasks, persistence, liking the class, and effective learning and problem-solving strategies. Conversely, performance goals are associated with avoidance of challenging tasks, the belief that one lacks ability in the face of failure, and the use of superficial learning strategies.

The purpose of this study was to provide an example of how engineering programs can examine additional student characteristics, beyond demographic variables, to possibly better understand recruitment and retention in engineering education. Herein, we investigated engineering students’ achievement goals, both generally (e.g., It is important for me to do well compared to other students) and specific to engineering courses (e.g., It is important for me to do well compared to other engineering students). We examined differences in achievement goals for freshman male and female engineering students as well as differences in freshman students who persisted in engineering versus those who transferred out during the first year. Preliminary results indicate that engineering students differ in their general vs. engineering course specific achievement goals. Specifically, engineering students reported lower levels of PAP, MAV, PAV, and WAV for their engineering courses. Furthermore, males tended to be higher on WAV than females but lower on MAP and MAV than females. Finally, there did not appear to be any difference in general achievement goals for freshman engineering persisters versus switchers.
Commuter Students’ Educational Experiences and Sense of Belonging in the Undergraduate Engineering Community: A Phenomenological Study

Jenny Linn Smith and Julie Martin Trenor

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Extended Abstract

The purpose of this study is to describe the “lived experience” of commuter students attending an urban institution. Participants were 28 ethnically diverse students who commuted more than 15 minutes each way to campus. We employed Astin’s Input-Environment-Outcome (I-E-O) model as the conceptual framework to investigate commuter students’ sense of belonging within the undergraduate engineering community.

Interview transcripts were analyzed using Creswell’s phenomenological research methodology. Four common themes or “clusters of meaning” were found to play an important role in the development or hindrance of participants’ sense of belonging in engineering.

- Commuter students experienced a delay in development of a sense of belonging within the engineering community.
- Enrollment in engineering courses and programs contributes to a sense of belonging once students gain access.
- Peers in engineering majors are an important source of support.
- Commuter student status hindered time and energy necessary for campus involvement.

These themes were integrated into the phenomenological “essence” of the participants’ experiences. In this paper, we also offer implications for practice for the Engineering Educator of 2016 by including suggestions based on these results which may help minimize potential delays in commuter students’ sense of belonging and promote integration into the undergraduate engineering community.
High Altitude Student Ballooning Project: An Intensive Research Experience for Undergraduate Engineering Students

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EXTENDED ABSTRACT

Student ballooning projects have been adopted by various universities over a decade as an affordable means of launching student built payloads to near space environment. Apart from the obvious scientific merit of such projects, one significant outcome is students’ exposure to cross-disciplinary and team oriented problem solving practice that is so much desired by the engineering community in today’s highly competitive global market.

Albany State University, a historically Black institution, participated in the Physics and Aerospace Catalyst Experience in Research (PACER) program during a 9 week long program in last summer. Under this NSF sponsored program, run by Louisiana State University’s Physics and Astronomy department and Louisiana Space Consortium, one or two faculty/student teams from minority universities are invited every summer since 2007 to undergo training, then design, develop and fabricate the payload and subsequently launch it from NASA’s Columbia Scientific Balloon Facility at Palestine, Texas. This year, student/faculty teams from Albany State University and Central State University from Ohio, went through the exercise, which culminated in an eventful launch and recovery operation followed by data retrieval and science presentation.

The summer program is being followed by a yearlong activity of designing and building two new payloads for new experiments by the students attending the transfer engineering program at Albany State University. The “Student Ballooning Course” has been taught in just concluded fall semester to make the students familiar with the basics of electronics, software, cost control, project management and above all technical writing in the form of Preliminary Design Review, Critical Design Review and Flight Readiness Review each of which has to be submitted by a pre-announced date. The design of the payload is now in progress which will be launched in early April locally not too far from the home institution. The experience gathered during the summer program, recruitment and logistics issues of conducting a non-credit course as well as the results from the upcoming launch will be discussed.
Student Success – Oriented Needs Analysis: A Conceptual Framework

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Extended Abstract

Student success research in higher education has provided an immense understanding of those factors that explain why students decide to leave, and to some extent, why students persist on to graduation. However, few studies have leveraged student success research to identify an inventory of needs that should be met in order for students to succeed in college. This paper leverages a collection of influential student success theoretical perspectives to develop a needs analysis framework to elicit and identify engineering student success needs. The conceptual framework provides a structured participatory method to translate vague student needs into actionable statements that holistically capture the needs of engineering students. Lastly, this paper outlines the importance of incorporating this framework into the development process for constructing an Engineering Student Needs (ESN) questionnaire.
Outreach Program in Civil Engineering and Traffic Safety for Fourth and Fifth Grade Students

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Abstract – This paper describes an outreach effort to teach fourth and fifth grade students about civil engineering in general and specifically the highway safety aspects of transportation engineering. The program consists of two 30-minute sessions, the first on civil engineering and the second on the transportation subdiscipline, particularly highway and traffic safety. The first session introduces the school children to the various subdisciplines of civil engineering and how the work done by civil engineers shapes their daily lives, from supplying clean drinking water to designing bridges to carry us across bodies of water. In the second session, transportation engineering is introduced with a focus on highway safety and rules of the road. Most of this session is devoted to the meanings of key traffic control devices (signs, markings, and traffic signals). The main content delivery mode is a computer slideshow presentation. The picture-laden presentation is supported by a variety of visual aids and passaround items. Examples include samples of sign sheeting, pavement marking material, and asphalt concrete cores. The outreach program was delivered by student members of the Auburn University Student Chapter of the Institute of Transportation Engineers. At this time, it has been delivered to two of the six elementary schools in Auburn, Alabama. These elementary schools conduct bicycle and traffic safety courses with their fourth and fifth grade students; an attempt is made to schedule the outreach activity in conjunction with the bicycle and traffic safety program. Plans are being developed to reach the remaining schools and develop an instrument to measure the fourth and fifth grade students’ understanding of the basic concepts and terminology. Key course objectives include creating an awareness of the impact that civil engineers have on the lives of schoolchildren and their families as well as presenting it as a career option.
An Early Start to Studying Shaky Ground: Teaching Seismic Soil-Structure Interaction Topics in a Sophomore-Level Dynamics Course

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Extended Abstract

Many structural engineers have limited experience concerning the dynamic behavior of structures subjected to strong shaking. At the undergraduate level, few students have opportunities to gain experience with the behavior of structures subjected to earthquake loading. In a survey, a group of practicing engineers and educators recommended that earthquake resistant design, and structural dynamics and vibration related topics should be taught at undergraduate level. This paper discusses the experience in introducing seismic soil-structure interaction to sophomore level engineering technology students at Southern Polytechnic State University. Learning outcomes and topics covered in a two week time frame are presented. Assessment of learning outcomes was done using an online exam, and two homework assignments.

Course Outline

Seismic soil-structure interaction topics were introduced in five lectures in a 2 credit-hour dynamics course. The lecture topics are;

Lecture 1 Basic earthquake terms, how earthquake happens, ring of fire, seismicity of U.S., seismic waves, and characteristics of ground motion

Lecture 2 Natural vibration of buildings, structural response to earthquakes, and resonance state.

Lecture 3 Dynamic analysis methods and static force method.

Lecture 4 An example problem on finding earthquake induced lateral forces for a 20-story building using UBC 97.

Lecture 5 Another example problem on earthquake lateral forces using IBC 2006.

Conclusions

The proposed five-lecture revision to a sophomore level engineering dynamics course for the purpose of delivering seismic soil-structure interaction related topics has been successfully applied. Survey results indicated that the civil engineering technology students benefited from the earthquake engineering related topics. The use of the cost-effective simple physical model significantly helped the students understand soil-structure interaction under ground shaking.
Preparing Students for the Practice of Civil Engineering

Thomas R. Dion, Kevin C. Bower, and Dennis J. Fallon

The Citadel

Extended Abstract

According to ASCE's *Commentary On the ABET Engineering Criteria for Civil and Similarly Named Programs*, one of the seven generally recognized civil engineering technical areas includes "Surveying/Measurements". This paper examines ABET program objective 3 (k) which focuses on 'an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice' and its relationship to courses relating to surveying and geospatial measurements. Some state engineering licensing boards include as part of their definition of 'engineering practice' various activities that focus on engineering surveying. In the practice of civil engineering, essentially every project utilizes some form of geospatial information to define existing site conditions as well as to provide line and grade for proposed improvements. It is therefore imperative that practicing engineers have knowledge of recognized datums and reference coordinate systems to ensure continuity of design while minimizing project related errors during planning, design, and construction.

In addition, the population of professionals practicing engineering surveying has dwindled over recent years. In the not so distant future there will be a significant increase in the demands for persons providing professional services in this area of practice. In order to meet these new demands, some institutions have developed four year ABET/EAC BS degree programs in Surveying/Geomatics Engineering. Other institutions have worked within the constraints of their financial and logistical environment to provide course work that would prepare students to practice engineering surveying whether they are registered or not.

The State of South Carolina is currently relying on its four year degree granting institutions to provide the necessary educational experience in this area of practice by utilizing existing programs of study. The approach used by The Department of Civil and Environmental Engineering at The Citadel to address these needs might be referred to as the 'classical approach' to engineering education. Students are afforded a broad foundation through its curriculum which includes a basic surveying course along with a separate course in Geospatial Measurements. The authors will discuss engineering surveying as it applies to professional practice, along with national trends in increased educational requirements to become a practicing surveyor, and some example efforts to improve the surveying community within a state by working with the local professional registration board.
Capstone Courses: Why They Work and Why They Don’t

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Extended Abstract

For an engineering capstone course to be successful, it must work for all parties involved: student teams, faculty, and practitioners. In this article, the authors will describe a typical capstone course and will discuss the benefits and disadvantages for those involved in a capstone course. The reported observations are based on the combined experiences of the authors, who have acted as capstone course instructor and mentor, engineering student employer, engineering practitioner, design course instructor, and judge of final capstone design presentations.

The authors argue that, instead of departments being required to have capstone courses, they should focus on the broader goal of integrating professional practice into engineering curriculum and should be able to decide how to accomplish this goal, with or without capstone courses. The inspiration of this broader goal came from the National Council of Examiners for Engineering and Surveying (NCEES) inaugural Engineering Award for Connecting Professional Practice and Education, the grand prize of which was won by two of the authors for their department.

Inherent differences between the university environment/capstone courses and professional practice are noted. The need for involvement by multiple faculty members and practitioners in the course is explained. Also discussed are the unique challenges of capstone courses, in terms of grading, differences in student opportunities, available mentors, faculty involvement and required expertise. Considering the limited maximum number of credit hours required for an engineering degree, the time should be spent carefully: preparing students’ attitudes for the practice of engineering; teaching professional skills at the forefront of design courses rather than at the end; integrating professional details in non-capstone design courses; and involving practitioners in ways in addition to or besides through capstone courses.
The Use of Clickers in Summer Undergraduate Civil Engineering Courses

Kenneth P. Brannan, Edward L. Hajduk, and John A. Murden

Abstract – During the summer of 2009, interactive student response pads, commonly known as “clickers”, were integrated into two junior level civil engineering courses at The Citadel. Summer courses at The Citadel are taught at an accelerated rate when compared to courses in the fall and spring semesters. For example, a three-credit-hour course conducted during three weekly one-hour classes in a traditional 14-week semester is compressed into 14 three-hour classes over seven weeks.

At the end of the two summer courses, a student survey was conducted to evaluate the effectiveness of clicker use in these courses. The responses showed that the majority of students in both summer courses (84%) found clickers to be helpful in keeping students actively engaged in class. In addition, the summer course survey comparison indicated that clicker effectiveness may be linked to integration of these tools into the course materials, as the course that incorporated clickers into a new learning technique was rated higher in keeping students focused in classroom (4.3/5 to 3.1/5) and helping them retain material (4.1/5 to 3.1/5) than the course which did not link clickers to a new learning technique.

Comparison of the summer course surveys to student responses collected from a civil engineering course taught during a traditional 14-week semester did not allow for an evaluation if course length and classroom time affect student receptiveness to the use of clickers. However, the comparison showed that regardless of whether the course was offered in a traditional or accelerated semester, 90% or greater of students would like to see future clicker use in classrooms.

Keywords: civil engineering, clickers.
Reflections on Mentoring FIRST LEGO® League

Kyle Kelley, Janis Terpenny, and Richard Goff

Mining and Minerals Engineering / Engineering Education and Mechanical Engineering / Engineering Education – Virginia Tech

Extended Abstract

FIRST LEGO® League (FLL) is a robotics competition for children ages 9 to 14. Regional and state competitions are held yearly around the nation. Each team must design and program a LEGO® MINDSTORMS robot capable of completing specified “missions”. Teams are also judged on a research project, teamwork, and robot design. The theme for the 2009 FLL challenge was transportation. This paper focuses on personal mentoring reflections from experiences mentoring a FLL team at a local elementary school. As a mentor, help was provided to the team to organize the design effort and provide guidance to the team whenever technical questions or conflicts arose. Reflections include a self-assessment as well as an assessment of the team, the benefits and learning opportunities provided by the mentoring experience, and an explanation of how others can get involved in similar FLL mentoring experiences.
Transportation – Learning on the Move

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Extended Abstract

There is currently a strong movement among some K-12 educators to improve the educational process by making what is taught in the classroom more relevant to the daily lives of students and more directly connected to future career opportunities. This is certainly the case in Tennessee where there is now a strong push for interdisciplinary theme-based curriculum. The University of Tennessee Center for Transportation Research has partnered with the Knox County School System to develop and implement such program built around a transportation theme.

Transportation is an essential part of everyday life for the vast majority of Americans. The very operation of our society is dependent upon an efficient and safe transportation system. The quality of the educational system has similarly far reaching impacts on the viability of a society. However, like transportation, the importance and impact of a high quality education are often under appreciated. In fact, some segments of America’s student population have historically been underrepresented in certain careers due in part to a lack of exposure to career possibilities resulting in a lack of desire or determination to pursue and develop a high level of skills in areas such as science, technology, engineering and mathematics (STEM).

The purpose of this project is to foster an increased desire among 8th grade students to pursue academic excellence in STEM disciplines by stimulating middle school teachers’ interest in technical fields who would then convey that same interest and excitement to their students. The project goal is to develop, implement, and evaluate a comprehensive transportation program targeted at female and minority students including a classroom-based curriculum, training for teachers, and a summer academy.

A comprehensive interdisciplinary curriculum meeting state mandated content standards has been developed and teachers at two pilot schools have been trained to teach the material. This two week long program was implemented in the two pilot schools in November/December of 2009. The impacts are now being evaluated. The next steps include revision of the materials and full implementation at addition schools during the fall semester of 2010.
The Use of Modeling and Simulation as an Instructional Strategy in High School Math and Science Classes

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Extended Abstract

In May, 2008 a Hampton Roads, Virginia school district approved a Modeling and Simulation Demonstration School Project at a district high school. The project incorporates modeling and simulation as an instructional strategy within math and science curricula. This project was undertaken based on the recommendation of the Hampton Roads Modeling and Simulation Initiative organized by Dr. Thomas E. Pinelli of NASA Langley Research Center and was implemented in partnership with the National Institute of Aerospace. Other partners involved with the project include Dr. Ginger Watson, Associate Professor and Research Faculty at Old Dominion University and the Virginia Modeling Analysis and Simulation Center, and isee systems, publishers of STELLA® systems dynamics modeling software.

During the 2008 – 2009 school year a team of three math and three science teachers mapped math and science curricula looking for connections among courses, developed lesson plans that incorporate modeling and simulation as the key instructional strategy, and participated in ongoing professional development. Teachers used both open source and commercial modeling and simulation tools to develop their lessons. This paper provides an overview of the implementation of the project; a description of work accomplished and lessons learned during the 2008 – 2009 school year; and the expansion of the project to other school systems for the 2009 – 2010 school year.
Empowering Teachers Through the Virginia 21st Century e-Teacher Graduate Series

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Extended Abstract

The Virginia 21st Century e-Teacher Series prepares teachers to meet the needs of learners in today’s classroom. This series is not another one-time professional development program. This program equips teachers with the knowledge to embed today's technology tools into curriculum and instruction, making them relevant for their students. The series also teaches participants to become life-long learners themselves, enabling them to keep abreast of the latest technological innovations in today's ever-changing world.

A team of professionals representing education and non-profit organizations has set the foundation for this program. The School of Continuing and Professional Studies at the University of Virginia provides the pedagogical basis and structure for a forward reaching teacher certification program. Core content is provided by LearniT-TeachiT’s 21st Century e-Teacher Initiative, a project that was piloted by The National Institute of Aerospace (NIA) and Virginia Beach City Public Schools. LearniT-TeachiT and NIA bring cutting edge science, technology, engineering, and mathematics (STEM) content and deep understanding of technology and its application in the classroom to the team.

Our goal is to build an alliance dedicated to training Virginia teachers and educational administrators to meet the challenges in preparing today’s learners to be successful in the global marketplace. By implementing the Virginia 21st Century e-Teacher Certificate, the Commonwealth will lead the way in changing, at a fundamental level, teacher professional development and will secure its position as a leader in preparing its learners for the challenges of the 21st century.
A Third Year Update on a Single-Gender Outreach Program

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Abstract

In 2007, the Herff College of Engineering at the University of Memphis hosted Girls in Manufacturing (GiM), a week-long summer outreach program which was designed to introduce high school girls to engineering. A presentation about the initial summer program was given at the 2008 ASEE SE conference.

This paper reviews the revisions and additions that have been introduced progressively into the second and third summers of this outreach program. The program has expanded the number of times per summer that the course is offered as well as changing the curriculum of the program to expand the hands-on component of engineering. The program has reached out to industry and obtained additional grants which allow the program to be self funded through the annual and multi-year grants. This paper covers the successes and frustrations associated with the planning, implementation and execution of the program. Additionally the paper will give the blueprints for a successful single-gender outreach program.

Keywords: K-12 Outreach, STEM, Single-Gender, Manufacturing, GiM.
Towards the Development of Programming Skills for First-Time-Programmers

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Extended Abstract

In this paper we discuss an introductory programming course pedagogy. The target students include both majors and non-majors. It is assumed that the students have had little or no exposure to computer programming past normal daily use of a computer. To begin the course we started with an introduction to problem solving independent of a specific computer language. They develop a set of methodical instructions to multiply two numbers. During this exercise, we emphasize the concepts of input and output as fundamental components of a program.

Next, we introduce them to various hardware and software components of a computer including input, output, storage, and processing. An analogy between a human’s problem-solving abilities and the computer’s abilities serves to help them understand that a computer will only perform clear and unambiguous instructions. For practice, we introduce them to a story-telling programming environment where they write a program to solve a problem in the form of a story.

Weekly programming assignments and programming quizzes leverage their newfound software concepts, bringing them to a more explicit understanding of the task of programming. Based on their performance on assignments and quizzes we were able to decide when to assign the students to work in groups or individually. Moreover, we decided to move the class to the lab for two weeks, during which we gave them programming assignments to be finished during class time while the instructor was present. This gave the students the confidence to solve the problems without the fear of making mistakes.

The remainder of the course focused on the beginning concepts of programming including variable declaration, program flow, programming language instructions, input/output operations, assignments and operators, conditional statements, and loops. We continually emphasized the program development cycle beginning with writing the code in a text editor, compiling, and finally running in an operating system environment. We used C, the gcc compiler, and the emacs text editor under the Linux environment giving them a subset of the Linux command set as tools.

We are advocating this pedagogy to improve non-major instruction as well as to better prepare majors for their first majors-based introduction to computer science course. We present survey results administered to the students at various points during the semester. The results of our survey show significant improvement over monthly intervals. We have incorporated this course into our annual course rotation.
Construction and Implementation of a Mobile Robot Platform in a Microcontroller / Interfacing Class

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Extended Abstract

In the typical microcontroller / interfacing class, laboratories would be assigned to teach the students how to use the various facilities of the selected microcontroller. Basic Input / Output, Analog to Digital conversion, Output Compare, and Input Capture would all be subjects for experimentation. Each of these learning objectives on their own can be accomplished with exciting experiments, but what if mobile robotics could be used to integrate these labs into a single system, building up the mobile robot’s hardware, software and abilities throughout the semester?

This is not a new idea, but with the budget constraints of recent times, is there a way to implement such a class that is cost effective, uses university owned microcontrollers, and is flexible to enough to be used for such a task and easily rebuilt or repaired to be used repeatedly?

This paper discusses such a mobile robot platform and includes detailed plans, parts lists and instructions on how it was constructed so that it can be replicated at other universities.

Also included is a discussion on how the robot platform was integrated into the fall 2009 offering of the senior level Microprocessor Interfacing Technology class at the University of Memphis Engineering Technology Department and a list of experiments and projects.
A Developmental Visualization Module that Starts with Inspection and Ends at Solid Modeling Using Real Objects

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Extended Abstract

We developed and deployed a learning module that promotes students’ comprehension of spatial relationships through inspection of common objects and drawing of rapid-prototype (RP) primitives. The module takes advantage of the natural interplay between object visualization and the use of measurement tools for object inspection. We approach spatial relationship comprehension developmentally through the following steps: 1) inspection of objects to identify them from a catalog, 2) inspection of RP primitives to create a two dimensional orthographic projection drawing with dimensions, 3) inspection of RP primitives to create sketches that are subsequently used to develop a solid model.

The engineering program at James Madison University includes significant hands-on content and design-build experiences. Such experiences afford students many opportunities for inspection and visualization. To support the requirement that students make accurate measurements and assessments of their work, we provide early training in the use of measurement instruments such as tape measures, machinist scales, calipers, and micrometers. This training presents many students with a first experience in length measurement and initiates development of intuition for size and scale. Students are then required to use such measurement skills to inspect and produce drawings of simple objects that were created using an RP machine.

This paper provides enough details of this module to facilitate its adaptation to other curricula, and the results of direct and indirect assessments of student learning. Direct measures of the module’s effectiveness include the results of quizzes and embedded exam questions. Indirect measures include the reports of in-class observers from the university’s Center for Assessment and Research studies. The assessment results and their implications to planned module modifications are also discussed.

This effort is funded by NSF CCLI Grant # 0837465.
Manuscript Publication Aided by the Open Journal Systems: A Case Study

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Extended Abstract

Public Knowledge Project’s Open Journal Systems is an integrated open source journal management and publishing system that facilitates the publication of over 2000 journals. Among the almost 600 sample journals Open Journal Systems lists are twelve that include the word “engineering” in their title and three that include the word “design” in their title. Among Open Journal Systems’ numerous features are the following: Open Journal Systems is installed locally and locally controlled; editors can configure requirements, sections, review process, etc; submission and management of all content is accomplished online; a subscription module is available with delayed open access options; comprehensive indexing of a journal’s content is part of a global system; reading tools for content is based on the discipline and editors’ choice; email notification and commenting ability are available for readers; and complete context-sensitive online Help support is available. The Engineering Design Graphics Journal recently transitioned from being a print-only journal to being an online-only journal aided by Open Journal Systems. Keys to the continued success of any transitioning journal include ensuring that authors can continue negotiating the submission, editorial, and publication process; reviewers can continue evaluating manuscripts; and editors can continue working with authors and reviewers with relative ease. Open Journal Systems’ integrated submission, editorial, and publication process makes this possible.
Blended Instruction in an Introductory Engineering Graphics Course: Understanding How Students Utilize Online Instructional Resources

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Extended Abstract
In a continuing effort to improve instruction, the faculty at North Carolina State University has made several major revisions to their introductory engineering graphics course. Over the past few years, the researchers have looked at ways that pedagogical innovations could be used to both improve instruction and do so more efficiently with fewer resources. First, the course format has been changed from face-to-face to blended learning. A second revision is that this online content has been moved from open web pages with online assessments in the Blackboard learning management system (LMS) to the Moodle open source LMS. Some of the reasons for moving to Moodle include: providing a vehicle to organize course content in an efficient manner; being able to track student progress through the instructional units; providing students with feedback on their learning through online assessments; and allowing the faculty to provide consistent instruction over all sections of the course.

During the fall 2009 semester, three blended learning sections of GC120 – Foundations of Graphics were studied. All online materials were accessed only through the Moodle learning management system. An additional difference in these sections from previous semesters was the enrollment for each section was set at a maximum of 60 students instead of the 24 in previous semesters. There were 164 students enrolled in the three blended versions of the course. A majority of these students were sophomores (70%) since GC120 falls in the sophomore year of many engineering majors. Eighty-two percent of the students were enrolled in engineering majors with the largest percentages coming from the departments of aerospace and mechanical engineering and civil engineering. As in previous semesters, students were required to view and complete online materials to satisfy a portion of the course. Materials were organized into 12 weekly online units. Each unit consisted of streaming media presentations of the textbook material, streaming media SolidWorks demonstrations, and streaming media sketching demonstrations. Students also had to complete a 10-20 question online assessment in units 1-5 and 8-11 as a check of their textbook knowledge. They were given two attempts at each assessment if needed. Of particular interest in this study was how students used the online materials.

This paper examines the order in which students progressed through the materials related to the textbook, the typical number of attempts student made at each online assessment, and whether students who attempted all of the online assessments performed better on the midterm and final exams than students who only attempted a few assessments.
An Experiment in Learner–Centered Instruction in Aerospace Engineering Capstone Design

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Engineering Education / Engineering Education & Mechanical Engineering / Engineering Education Virginia Tech

Extended Abstract

The engineering capstone design course is the culmination of all previous undergraduate training in engineering expressed in the act and art of design. In the Aerospace Engineering Department of Virginia Tech, Aerospace Engineering Seniors interested in aircraft design can work on the conceptual design of an aircraft that is defined by the yearly Design Competition sponsored by the American Institute of Aeronautics and Astronautics (AIAA). This paper explores the aircraft design course and the impact on student learning of an experimental interactive lesson on the use of CAD in aircraft design. In the present design course, CAD is not covered and the course follows the teacher-centered paradigm. This learner-centered approach attempted to engage the students in an interactive CAD experience with the goal of an initial layout of an aircraft. Initial student feedback for the lesson was positive. Future work should include refinement and expansion of lesson material.
The Effect Knowledge Dissemination Structures Play in Increasing Design Efficiency in Small Design Teams

Aaron Noble, Richard Goff, and Janis Terpenny

Mining and Minerals Engineering / Engineering Education / Engineering Education and Mechanical Engineering - Virginia Tech

Extended Abstract

In design projects, decisions made in the latter stages of the process are dependent on previously presented information. When this information is not easily accessible or effectively communicated between team members, inefficiencies and rework are abundant. To mitigate these complications, specific knowledge dissemination structures may be used to facilitate formal communication. Working with three-member teams in a mining engineering senior design course, a graduate student mentor assisted the implementation of two tools: a master spreadsheet used to track essential design variables and an online filebox used to store this spreadsheet and other relevant files. The implementation difficulty and efficiency gained from these tools was anecdotally assessed by personal interviews. The results show that these tools are highly effective in increasing group productivity. The analysis and applicability of these results is discussed along with a plan for extended, quantitative research.
Updating an old course: What does it take?

Zeshan Hyder, Zulfiqar Aly, Janis Terpenny, and Richard Goff

Mining and Minerals Engineering / Mining and Minerals Engineering / Engineering Education and Mechanical Engineering / Engineering Education – Virginia Tech

Extended Abstract

This paper presents a scheme for updating an old course. A case problem approach is provided to support the description and demonstration of the course update scheme. The course titled “Insitu Measurements and Monitoring in Rock Engineering” had not been offered by the Mining & Minerals Engineering Department at Virginia Tech since 1992. The redesigning of this course included: defining the objective/need of this course, analysis of the old contents, consultation with teachers and experts in this field, literature review of the subject being redesigned, review of similar types of the courses offered by other universities, finally upgrading the course material by inclusion of new research and development. The decision making/planning tools like SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis, Gantt Chart and House of Quality were also employed in this redesigning process. The procedures presented in this paper may be useful for anyone who intends to re-design/upgrade courses that have not been taught in recent years or that have become outdated due to technology advances or new approaches to learning.
The Role of College Sponsored Freshman Projects  
Engaging Freshmen - Engaging Faculty

Cecelia M. Wigal, Ph.D. P.E.  
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Extended Abstract

In many engineering programs, especially those that are large, freshmen engineering students have limited contact with engineering faculty. In smaller programs, freshmen students may have contact with a few engineering faculty through introductory engineering courses; though most contact is with faculty in the math and supporting sciences disciplines. The result is that freshmen students are not engaged with the engineering program and the engineering faculty are not engaged with the freshmen students.

How can this engagement be improved? Studies indicate that Project-Based Learning (PBL) is one means to increase student engagement. Further research indicates that this engagement results in increased student retention; thus students are more likely to persist and graduate in settings that involve students as valued members of that academic community.

This paper, through the discussion of a course structure and course project outcomes, suggests that, though it is proven hands-on learning improves student retention there are other equally important outcomes. The course introduced is the program required Introduction to Engineering Design (IED) course. In this course engineering students work on projects supported by faculty of sophomore, junior, or senior level courses, faculty with supported research or faculty advising student engineering society projects or upper level design projects. The instructors find that these projects provide faculty-student mentoring opportunities, build student-faculty relationships, and empower student engagement.
An Undergraduate Nuclear Certificate Program

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Abstract

To promote awareness of nuclear energy and to prepare workforce to meet the growing demand in the nuclear energy sector, several courses on nuclear energy and nuclear engineering have been developed at North Carolina A&T State University, with a curriculum development grant from Nuclear Regulatory Commission.

Three new courses have been developed: a general elective open to all majors - Contemporary Issues in Nuclear Energy, and two engineering electives: Nuclear Energy and Nuclear Engineering and Nuclear Fluid Mechanics and Heat Transfer. In addition, two courses are modified to introduce nuclear contents: an industrial engineering elective - Systems Safety Engineering and Risk Analysis and an electrical engineering elective- Power System, Energy Conversion, Electrical Machinery

With these elective courses, an undergraduate Nuclear Certificate program is being considered for engineering majors. The certificate program will raise the profile of the nuclear field on this campus and will give students an edge to compete for nuclear related jobs in industry and government agencies.

To gain faculty buy-in and raise students' awareness, the author offers a series of nuclear seminars to help transition from a group of nuclear courses to a nuclear certificate program.
Semiotic Interface Design

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Extended Abstract

This paper offers an interpretation of the theory of semiotics within the software engineering design of new interfaces for computer systems. Currently a specialized user interaction engineering course at Southern Polytechnic State University is exploring the fascinating body of knowledge called Semiotic. This interdisciplinary science studies all types of signs and symbols as elements of communicative behavior. We use this study of signs to investigate specific computer system interfaces domains, their representation and interpretation by the end users.

The Science of Semiology in Interface Design

In a semiotic sense, signs take the form of words, images, patterns, sounds, and objects. We describe the overall organization and content of the interface as a sign system, which promotes the user while working on a computer to experience the interface as a complete “language” to accomplish their tasks. Semiotic morphisms, which is the movement (translation, interpretation, representation) of signs from one system into signs in another system are also included in the study for effective interface designs.

Inventions of new interfaces greatly benefit from in depth analysis to the vocabulary of signs used throughout the computer system used by end users. The paper will include discussion of the different media and genres within the current interface sign systems, how they provide the user with different frameworks for representing task experiences, and examples of signs facilitating forms of expression in the work force and society.

Semiotic Development in Interface Design

The methodology presented in this paper uses the fundamental semiotic analysis and synthesis of proposed interface communications to achieve a semiotic morphism in the computer systems used by the end user. Semiotic is a sign based language composition and development. The underlying thoughts are that interfaces viewed by end users are a sign based system. The end user looks at the interface, identifies the signs of the interface that correlate to their task sequence. Their previous interface knowledge guides them in the action sequence with the signs seen on the interface to result in the task goal wanted. Using this semiotic dialogue, the end user implements sign specific interaction achieving highly succinct and efficient interactions with the computer system. The purpose of studying, designing, implementing, and evaluating semiotic systems for end users is fundamentally based on the continuing striving for better user interface experiences.
An Infrastructure for Teaching CS1 in the Cloud

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Extended Abstract

A key goal of entry level computer science classes is the recruitment and retention of potential computer science graduates. Many entry level classes struggle to show students the real world context and social and societal impact of computer science. Modern Web 2.0 applications provide an attractive way of putting computer science in a realistic context. However, efforts to teach such applications in a first CS course are hampered by the fact that they require a deep understanding of multiple and complex concepts and technologies. Rather than focusing on learning core computer science concepts, students would need to learn transient and technology-specific knowledge.

This paper presents the initial design of CloudSpace, a teaching environment that allows students to understand core computer science concepts in the context of modern web applications. CloudSpace presents entry-level CS students with a virtual environment to develop web applications in a manner similar to the development process of desktop user interface applications. For example, CloudSpace allows students to work with abstractions such as a console and or a file system that mimic the environment in which traditional programs run. This virtual environment also shields students from the distributed nature of the web technologies with which they work.

To populate these virtual environments with real-world data, CloudSpace will be equipped with API’s to access data from the Internet. CloudSpace will feature a rich library for accessing RSS feeds, on-line video clips, on-line CSV data sources, and generic web page content. Rather than working with dull datasets, this library allows students to integrate real-world and life data sources into their applications.
Development of a Large Scale Virtual Meeting Space for Drug and Alcohol Aftercare Counseling
Source Code Plagiarism and the Honor Court

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In the year 2016, as most students entering a college or university will have grown up with personal computers and the Internet, there will likely be a great demand for courses on computer software and engineering. Many students will want to be exposed to computer programming, and many of those will struggle with the subject, as they do today. Some of those students, as some do today, will turn to plagiarism in order to complete their programming assignments.

Unless there is a dramatic shift in the attitudes of society in the next seven years, plagiarism will continue to be a problem in 2016, as it is today, and as it has been. At institutions where plagiarism rules are enforced by an Honor Court, when students are accused of plagiarism, a group of the students’ peers serve as a jury to render a verdict on the charges. The members of the Honor Court are usually sourced from across the institution, and many may have little to no computer programming experience, which can present difficulties when they are asked to hear cases of alleged source code plagiarism. A survey of these members, the results of which will be discussed in this paper, indicates that they tend to rely on evidence presented by automated plagiarism detection systems over their own ability to assess whether or not plagiarism has taken place.
Factors Affecting the Performance of Students in a Data Structures Course at Fort Valley State University

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Extended Abstract

Data Structures is a key course in the curricula of both computer science and Computer information systems (CIS) majors at Fort Valley State University (FVSU). It is a junior level and lecture-based course that is perquisite to several advanced courses in both majors. The relatively poor performance of students in classroom and an in-house exit exam evaluated over the past several years indicate the difficulties students experience to apply concepts of data structures correctly and efficiently. This paper provides results of a survey aimed at investigating several factors that could have influenced the performance of students in the course both quantitatively and qualitatively. The analysis of the survey data revealed that course topics, workload and student involvement, and textbook selection were major factors that students believed affected their performance in the course. Based on the results, a two-prong approach was suggested to address these concerns at FVSU. The first approach would be vertical integration of relatively complex concepts in pre-requisite courses that emphasize algorithmic design and implementation rather than program coding. The second approach would be a supervised lab to help students with implementation of course concepts through real-world applications and the utilization of interactive multi-media demonstrations.

Although the solutions to these problems are not always straightforward and crisp, the two-prong approach suggested in this paper could help improve the performance of students. We are planning to implement these suggestions in the future offering of the course at FVSU.
Greening the Educational Experience: Strategic Entry Points for Sustainability in the Existing Curricula

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**Extended Abstract**

Interest is growing around the world regarding the principles and practices of sustainable construction. This interest is being driven by increased recognition of the responsibility of the construction industry for significant social, economic, and environmental impacts, even as it strives to meet the needs of a diverse and growing population. As colleges and universities seek to evolve their curricula and programs to respond to this opportunity, the challenge is to find ways to increase the sustainability-related knowledge and skills of students in the context of an already full palette of educational requirements. The most common tactic, development of new elective courses, not only increases teaching loads and competes with existing courses in the curriculum, but it also isolates the concept of sustainability pedagogically and increases the perception that it is an optional specialty rather than an essential concept for all graduates. How can students most effectively learn the sustainability skills and information they need to know to be successful in today’s industry? Where are the most strategic entry points in existing curricula to introduce these concepts?

This paper presents an overview of six strategic entry points for sustainability in a typical construction- or engineering-oriented curriculum. It compares the pedagogical costs and benefits of each approach and shares lessons learned from experiences at two leading public American universities: Georgia Institute of Technology and Virginia Polytechnic Institute. The paper discusses opportunities in terms of three distinct perspectives on the pedagogy of sustainability: Stealthy Sustainability, Flagrant Sustainability, and a hybrid approach that combines the two over time as part of a strategy of diffusion and routinization of this innovation within existing curricula. The paper concludes with a discussion of considerations that should be taken into account when evaluating the potential for sustainability in new educational contexts.
Situativity Approaches for Improving Interdisciplinary Team Processes

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**Extended Abstract**

In order to successfully adapt to accelerating technological innovations that are being globally interconnected, engineers of the next decade will need to present strong abilities to think innovatively, which requires synthesis of interdisciplinary expertise. However, the current curriculum does not sufficiently prepare engineers with the essential collaborative skills to handle interdisciplinary teamwork. An interdisciplinary design class as a special topics course in which students would design state-of-the-art firefighter protection was assembled during the fall semester of 2009. Twelve fourth-year students, four from each of the three different academic disciplines (electrical and computer engineering (ECE), industrial design (ID), and marketing (MAR)) participated. For the data collection and analysis, both quantitative (questionnaire, assessment of course assignments) and qualitative (direct observation and interview) inquiry was used. A content analysis was conducted on the transcripts of the observations and the interviews. Nonparametric one-way analysis of variance was conducted for the quantitative data with academic discipline as a factor. A content analysis was conducted for observation and interview data. Two questionnaires, the Organizational Culture Profile (OCP) and the Uncertainty Avoidance (UA) items were used to identify different characteristics associated with disciplines. For the Organizational Culture Profile, the Kruskal-Wallis test revealed significant differences of one item at .05 level and six items approaching the conventional significance at .10 levels. The Kruskal-Wallis test did not reveal significant differences in Uncertainty Avoidance items among the three disciplines, but the mean score indicated that this class had higher than neutral overall uncertainty avoidance. The observation revealed contrast between engineering students and design students as well as role assignments and separations based on disciplines. The students presented effective team communication patterns with little conflict among members. They worked with each other without visible conflicts, and active discussions about the project were evident throughout the semester. However, little evidence of knowledge integration or interdisciplinary learning was found. Also, varying degrees of dominance in the communication was observed. From the interviews, an evident separation between design students and non-design students in terms of familiarity with the design process. Also, everyone agreed that the goal of the project was open for too long, and the instructors were not clear about the expectations. Based on the findings, a few strategies for a successful interdisciplinary design are suggested. First, an interdisciplinary design class needs to integrate a clear structure. Second, concrete project goals that require expertise from all disciplines need to be set. Third, smaller interdisciplinary work teams will need to be formed to ensure the quality of team communication that encourages more interactions.
Faculty Strategies for Facilitating Interdisciplinary Collaboration

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Extended Abstract

In response to ABET accreditation requiring engineering graduates to be capable of collaborating on multidisciplinary teams, faculty across the US have begun to develop multi- and interdisciplinary courses and collaborative experiences for the undergraduate curriculum. Typically, students encountering these experiences are not taught or mentored in practices for interdisciplinarity, because faculty do not have pedagogical practices for these contexts. By identifying these barriers, faculty can begin to create potential interventions and pedagogies to promote interdisciplinary collaboration and learning.

One such barrier, disciplinary egocentrism, has been identified and described in previous publications. Disciplinary egocentrism addresses 1) relatedness, or students’ ability to create connections between an interdisciplinary topic and a specific discipline, and 2) perspective, students’ ability to see beyond a specific discipline to begin to incorporate knowledge, beliefs, methods, and values from other disciplines.

Building on prior work, this study uses the framework of disciplinary egocentrism to examine faculty roles in facilitating interdisciplinarity. The team selected for this study participated in a green engineering capstone course. Specifically, observation notes and a transcription of an audio recording from a team meeting with a technical advisor were selected for this analysis. This particular meeting was selected from a series of team and technical meetings in which the students were developing a testing plan. Developing the testing plan became a complex task because the students drew upon their disciplinary and practical viewpoints to explain concepts and argue strategies. In this meeting, the advisor provided additional insights and mediated some of these differences. Further analysis of the interactions between students as well as the technical advisor reveals opportunities to develop strategies and/or interventions to guide students through conflict to reach a shared understanding of content knowledge. This paper will discuss the observations and present strategies faculty can use when guiding students through such conflicts.

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Faculty’s Self-Determined Engagement as the Key to Advancing a Culture of Assessment

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Extended Abstract

Faculty are under immense pressure today, asked to handle increasing enrollments, shrinking budgets, increased demands for research, and rising expectations of teaching quality, while balancing all this with their personal lives. Within the rising expectations of quality teaching lies assessment, which is gaining momentum in higher education objectives. The goal of integrating assessment into the educational culture is explored in this paper by delving into the background and progress toward cultures of assessment, the role of self-determination theory in autonomous growth of culture, and the notion of self-determined engagement. The claim is that self-determined engagement in assessment tasks is the essential and overarching requirement to integrate assessment into the culture of teaching and learning, thereby forming the desired culture of assessment within it. The claim is explored here through a review of the literature and is the basis of the first author’s dissertation work, which is in progress.
The Need for Adapting Engineering Education: Preparing Engineering Students for New Employment Environments a.k.a. Nuclear Power

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Extended Abstract

There are changing needs and demands for educating the engineering student in new, evolving or transforming technologies. One such case is the revival of the nuclear power industry. This impeding rebirth is providing a heightening demand for the “nuclear engineer” graduate. Although this is a specific case, it is illustrative to a new look at educating the undergraduate engineering student for an emerging field.

This paper illustrates an approach for supporting the revival of nuclear power with engineering graduates equipped to function in that environment without instituting a nuclear engineering degree. The underpinning principle of the approach defines the fundamental skills and knowledge base needed to effectively integrate graduates into the nuclear industry. From this the instructional curriculum is developed from the traditional engineering course menu available.

The paper describes the needed principles identified and reviewed with the constituents. The review of the preparation needed from traditional engineering disciplines, new topical needs, and new levels of course materials identified as necessary to support the approach are also presented. The fundamental building block of this approach is the belief in the sound preparation of an “engineer” from which the necessary “add-ons” in knowledge are provided to round-out the students’ preparation for entering the chosen area. This curriculum concept for nuclear power is applicable across “traditional engineering disciplines” as well as to other evolving technological areas as long as engineering fundamentals are strongly emphasized.

The topics addressed in the five-course tract are noted. The knowledge packets are referenced to a nuclear course curriculum offered in a nuclear engineering BS program. The courses are integrated into a curriculum which illustrates academic preparation of an engineering graduate rather than a traditional “nuclear engineer” graduate. This approach permits the graduate to work as an engineer rather carrying a tag of a nuclear engineer if the individual wishes to move to different engineering career positions.

The University of Tennessee at Chattanooga (UTC) is implementing this approach. UTC is located in the center of an evolving nuclear industry with such entities as TVA, Alstom TurboGenerator Group, and Westinghouse having significant operations here.
Interdisciplinary and experiential approach towards the teaching of materials science and engineering

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Extended Abstract

In industry engineers and scientists with varying backgrounds are expected to form effective project or product teams in order to solve problems and advance technology. This stands in stark contrast with engineering students’ academic experience where they are typically exposed only to discipline-specific courses within their major department. Too often a student’s first experience in interdisciplinary teamwork is at their first job where they are required to work well within a team that capitalizes upon the complementary strengths of team members from various backgrounds. These gaps can be addressed through college experiences where interdisciplinary teaming is encouraged.

Within the Bagley College of Engineering (BCoE) at Mississippi State University (MSU), the basic engineering disciplines are represented with the exception of a Materials Science and Engineering (MSE) department. To address the lack of a MSE department, an interdisciplinary Materials Working Group (MWG) was formed in 1995 to bring together faculty from across the university with an interest in materials research. In addition to fostering collaborative research, the MWG also teams faculty for co-teaching materials-relevant courses.

ChE/ME 4624/6624, “Experimental Methods for Materials Research”, is a four credit hour course co-taught between the Chemical Engineering and Mechanical Engineering departments. Offering the course across multiple departments helps satisfy major department course requirements, provide some student contact hour credits for co-teaching departments (a factor in tight budgetary environments), and can alleviate student fears about taking a course outside their home department. This interdisciplinary course is concerned with how to approach the testing and characterization of a wide range of materials. Pros and cons of various techniques are taught in an effort to illustrate how various testing and characterization methods can be selected and employed to provide data that will hopefully fit together like pieces of a puzzle upon which conclusions can be drawn. As more pieces of the puzzle are obtained, the more confident one can be in the conclusions drawn.

To enable ideas and concepts to be reinforced, the lectures and laboratories are coordinated through the selection of certain material systems that can be used to illustrate a concept during the lecture and then also examined in the laboratory. Based on the interests of the instructors, a recent offering of ChE/ME 4624/6624 utilized a series of polyethylene (PE) samples as a representative polymer system. This sample set was also used to highlight how collaboration between researchers with different specialties or interests can further the overall understanding of a particular material system.
Initiating the Undergraduate Research Study through the NYC-LSAMP Summer Fellowship

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Abstract: Through the NYC-LSAMP summer fellowship program we have conducted a research project “Understanding and Studying of a Non-invasive Optical Glucose Sensing System Using the Advanced Opto-Electronic Technology” with a freshman student. There were some challenging points due to the student’s level of engineering knowledge, we started to provide a series of mini-lectures in order to explain step by step the background knowledge in optics, electronics, physics, etc. in the beginning weeks. We also introduced and demonstrated basic opto-electronics equipments and devices including the oscilloscope, the laser, an optical chopper, a polarizer, a photo detector, a lock-in amplifier, etc. During the research project, we studied and investigated the fundamental knowledge and technology of opto-electronic devices with an understanding of their applications. In addition, we also investigated how a particular optical sensor works as a special application such as a glucose sensor for diabetics, and also attempted to design a glucose sensing system. In this study, we discussed the importance of undergraduate research and achievement of the preliminary study. The undergraduate research truly helped our student gain intellectual and practical knowledge of how engineering research is conducted and completed. Through the various research activities required by NYC-LSAMP Summer Research Program, the student also learned and improved his ability to achieve critical thinking, problem-solving & trouble-shooting skills, understanding engineering knowledge, increased confidence, enhanced career preparation, communication skills, etc.

Key words: Undergraduate Research, NYC-LSAMP Program, Opto-electronics, glucose sensor.
An Updated Approach for Preparing Mechanical Engineering Students for the Machine Design Industry

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Mechanical Engineering / Mechanical Engineering / Mechanical Engineering / Engineering Education and Mechanical Engineering / Engineering Education – Virginia Tech

Extended Abstract

While design education has improved significantly at Virginia Tech over the last several years, with courses in the first, second, and senior years that challenge student teams to take on realistic (and often real) design problems, the junior level machine design course remains limited in scope and practical use. Recently, a much greater emphasis for the junior and senior years of the Mechanical Engineering (ME) program is placed on fluid sciences, heat transfer and thermodynamics. While this is a strength of the program, there is an opportunity to create a strong mechanical design curriculum for upperclassmen. This paper presents a secondary two-semester machine design class for senior and graduate level students. This class would build on theories introduced during previous engineering courses.

A novel approach to machine design education is put forward that combines different methods of solving design problems with various teaching and learning styles. The course will have three distinct sections: advanced mechanics theory, design optimization, and design for manufacturing. The advanced mechanics section will cover situations that are likely to be seen in a real world design problem and focus on developing student knowledge from a theoretical foundation. The design optimization section of the course will focus on how to choose the best design for the situation based on a set of machine design criteria. This section will use various methods including MatLab optimization codes, and will combine theory and practical knowledge of machine design. Finally, the design for manufacturing section will show students how to communicate designs to individuals or companies responsible for manufacturing. This section will focus on the knowledge of standards and manufacturing processes, and will include some hands on and visual learning in a machine shop environment.
A Curricular Model for a One Semester Capstone Course in Engineering

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Extended Abstract
Achieve objectives of engineering design course through the jansen project and a design sample

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Abstract: Objectives of a project oriented course in mechanical engineering, Engineering Design, were achieved through a design project where students designed, built, and demonstrated an extreme version of basic Theo Jansen device. Through this project, junior students in University of Louisiana fully developed the capability of applying mathematic and kinematic knowledge in the analysis and design of mechanisms. Students also developed oral and written communication skills as they were used in design environments through the presentation of results in both oral and written forms. An assessment of the design project indicated that effective teaching and learning spread through the semester with the junior students acting as project managers and experiencing design practices. An example of student designed Theo Jansen device is presented in this paper to show the study results achieved by our students.
Etiology of the Energy Crisis in One Lecture

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Extended Abstract

A dominant feature of the twenty-first century has been concerns over the costs, availability, economics, security, and environmental issues associated with energy in the United States and the rest of the world. The paper is an extension of presentations made by the author over the past few years to audiences as varied as freshmen-to-senior engineering students, practicing engineers, political leaders, and the general public. Using energy use and cost data from the DOE Energy Information Administration and the World Bank, a cogent presentation can be crafted that suits various audiences and that can be readily updated as new information becomes available. The paper contains elements of the etiology of the energy crisis suitable for engineering students as well as data relative to what might be done to mitigate the energy crisis. Essentially all of the information is available in the public domain, but the information is assembled into a cogent sequence that contains the following elements:

1. Per capita energy use as an indicator of standard of living
2. History of energy use and sources in the United States
3. 2008 United States energy flow diagram and explanation
4. 2008 United States energy use in categories (commercial, industrial, transportation, and residential)
5. Renewable energy contributions in 2008 for the United States
   a. Realities and potential
6. 2008 United States petroleum flow diagram and explanation
7. 2008 United States coal flow diagram and explanation
8. Lost opportunities and why
   a. History of electricity prices (inflation adjusted) from 1960-2008
   b. History of motor gasoline prices (inflation adjusted) from 1960-2008
9. It's worse than we think—world energy use from 1996-2007
10. Where do we go from here?

Awareness and understanding of the United States energy situation is vital for tomorrow’s engineers—our students today. Future engineers must interact with and advise the general public as well as political leaders on energy issues. The energy education of future engineers is especially important as neither of the major political parties has yet to champion a realistic and workable energy policy for the future.
iGrads@VT: An iPhone Application for Graduate Recruitment

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Extended Abstract

We present iGrads@VT, an iPhone application that the Graduate School at Virginia Tech is building, aimed at personalizing graduate recruitment information. A potential graduate student might use this application to get personalized information on their academic and extra-curricular interests. We believe that such an application will not only provide the student what he/she needs to make an informed decision about their choice of graduate school, but also will provide them support for the changes and social adjustments needed to succeed in their graduate studies.

Selecting a graduate school involves identifying possible departments, degree offerings, financial opportunities, faculty mentors, as well as identifying costs of living, and other aspects regarding social settings of the graduate school of choice. This information is often found on the website of many graduate schools. Personalizing this information would make it easier for potential graduate students to access the relevant information while ignoring information that is irrelevant to the concerned student.

The sources of information to help a potential student make a decision can come from current students, faculty, and/or alumni. They help provide specific information required by the potential student such as information on degrees, courses, research groups, organizations and groups of interest (e.g. women’s groups, mothers’ groups, etc.), research group information, courses, etc. as well as a “personal” touch to standard information found in websites and brochures, so potential students can relate to that information in a better way.

With mobile devices gaining popularity, many universities are providing access to admission-related and various other information through mobile phone applications, such as iPhone applications (i.e. Stanford University, Duke University, etc.). However, most of these applications are limited to providing standard information (present in websites and brochures) and lack the “personal” touch of connecting with current students, faculty, researchers, alumni, and other potential students. In this paper, we present the software architecture design and a prototype of iGrads@VT, an iPhone application aimed at providing a potential graduate student personalized information, including select courses, relevant social groups, points of contact, etc. – all relevant to the potential student’s profile and interests. We believe that this tool will be useful to potential and current students on the move who need to access information and connect with others.
Freshman Engineering Student Perceptions of Engineering Disciplines

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Extended Abstract

As part of an ongoing effort to expand the engineering enrollment at the University of Memphis, the Department of Civil Engineering has undertaken a study to examine how entering engineering students view the various fields of engineering science and technology that are available at the university. One part of the study consists of a perceptions survey given to entering freshman in the college. The survey was given to students in the freshman classes presented by the engineering and engineering technology programs. The college has majors in Biomedical, Civil, Computer, Electrical, and Mechanical engineering as well as an Engineering Technology program with concentrations in computers, electronics, and manufacturing. This paper presents preliminary results and basic analysis of the survey data from the Fall 2009 Herff College of Engineering students. The data indicate that students selecting an engineering or engineering technology major view the major as having a significant impact on society and strong career opportunities, but do not perceive creativity to be important in these disciplines. Future efforts for refining the survey instrument and expanding survey participation are described at the conclusion of this paper.
Faculty Student Advising at Western Carolina University

Dr. George Ford, P.E. and Dr. Chip Ferguson

Abstract - Student advising is often an additional duty for engineering and engineering technology faculty members at higher educational institutions in North Carolina. At Western Carolina University (WCU), student advising is officially a part of the duties of a professor. The authors perceive that many professors at WCU do not enjoy academic advising and view the responsibility as a burden and time consuming task. Advising loads are typically not a tenure promoting duty nor are there explicit rewards for excessive advising loads or stellar performance. Coupled with the fear of professional liabilities, the previously mentioned problems with advising responsibilities may lead Professors to develop negative feelings towards advising students. The discussion which follows will briefly review: the framework which applies to faculty legal liability; the expectations of student advisees and faculty advisors based upon WCU policies; the Family Educational Rights and Privacy Act (FERPA), and the authors’ opinion on the potential liability for faculty who advise at WCU.

Keywords: student academic advising, faculty liability, student retention, mentoring
From the Classroom to the Operating Room: Cutting Edge and the Student

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University of Tennessee at Chattanooga/200 Graduates of University of Tennessee at Chattanooga

Extended Abstract

Very often students move through their baccalaureate career learning a spectrum of topics, principles, methodologies, and processes which will translate to them becoming effective engineers as they embark on their professional careers. The senior capstone project is designed to integrate many of these elements into a culminating experience for the students. These projects can take on many forms and directions depending on the respective faculties and institutions.

For the industrial engineering students at University of Tennessee at Chattanooga (UTC), a capstone project was chosen which gave the students the capstone experience and an experience in the practice of the engineering in the field. The project was one that none of the students in the course had ever considered before in their academic careers and also placed them at the front of an emerging area for industrial engineers. The project brought the students from the classroom to the operating theater at a local hospital. The students were introduced to this new environment, charged with investigating three potential projects, and defining the project of choice.

This paper describes the elements undertaken in the project of defining processes conducted and methods for improvement of the turn around time of operating rooms. In the course of initiating and executing this project, the realities of working in a functioning environment outside of academia were encountered and are detailed. The team’s learning needs are discussed and presented as the project progressed to completion. The team was able to deliver suggestions for change in the current turn around methods after three months of working on the project.

The significant benefit to the team beyond the capstone project experience discussed is the experience of defining, stating, planning, executing, reporting, and concluding of an actual, physical project in the healthcare arena which is evolving as a productive and high profile area for industrial engineers. The bringing of students to the “field” for such projects affords them more than just the academic preparation. The students are exposed to the importance of interpersonal skills, the functioning in a diverse and active “non-academic” environment, and review of their work by “non-academics.”
Chapter 3 Student Poster Abstracts
Open Channel Flow Apparatus

T.C. Dinkins¹ and Drew Hammett²

Abstract - In the Mercer University School of Engineering Environmental specialization lab an open-channel flow apparatus was rehabilitated and used to model various properties of water flowing through an open-channel. The open-channel flow apparatus was designed to simulate various outflow control structures and provide a visual model of a hydraulic jump. Outflow control structures help facilitate volumetric flow rates and allow for direct measurements of flow through an open-channel. The outflow control structures tested were two V-notch weirs of varying angles and an orifice plate. Data was collected experimentally to determine how water flowed through both outflow control structures. This data was then used to develop volumetric flow equations for both the V-notch weirs and orifice plate. The open-channel flow apparatus was also used to produce a hydraulic jump. A hydraulic jump occurs when there is an abrupt transition from super-critical to sub-critical flow and is a function of the flow’s Froude number. Once a hydraulic jump was reproduced in the laboratory, data was collected from all sections of the jump.

The open channel flow apparatus was set up to perform different tests by installing the control devices in the channel and subjecting them to varying flows. The control devices tested were designed and built out 6x8x0.25” thick Plexiglas plates. The control devices consisted of a 60° and 90° v-notch weir and an orifice plate with a 1” diameter hole. The control devices were individually subjected to the same flow and experimental data was obtained. The hydraulic jump was produced by adjusting the angle of the downstream gate.

In this series of experiments the open-channel flow apparatus successfully modeled the effect V-notch weirs and an orifice plate as outflow control structures. While the 60° V-notch weir and the 1” diameter orifice plate effectively predicted the actual volumetric flow rate, the 90° V-notch weir proved to be the most accurate way to calculate the volumetric flow rate in the system. A hydraulic jump was also successfully generated by causing a sudden change from super-critical to sub-critical flow due to changes in flow energy brought on by an obstruction in the flow downstream. Froude numbers were calculated for the critical, super-critical, and sub-critical flow sections. Respective velocities and specific energies associated with the hydraulic jump were also determined mathematically.

The work accomplished with rehabilitation of the open-channel flow apparatus in the Environmental specialization lab will provide for further student research opportunities. The flow apparatus can also be used to supplement classroom lectures for other departments in the School of Engineering that may include open-channel flow analysis in their curriculum.

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Alternative On-Site Sewage Management: A Bench Scale System for Evaluating Filter Media

Sarah Dorminy\(^3\), Jacqueline Lagratta\(^4\), Ryan Peters\(^5\)

Abstract - An on-site sewage management system provides treatment of residential wastewater on the property of a building that cannot be serviced by a traditional central wastewater treatment plant. A conventional on-site system consists of a septic tank and absorption field. Alternative systems are available for use when higher degrees of treatment are required due to sub-standard soils, high groundwater levels, or limited plot areas. Sand filters are an alternative system that can be included after the septic tank of conventional systems to better treat septic discharge before it is released to flow through the absorption field to the groundwater table. The design, operation, and maintenance of on-site systems must be regulated, as the owners and operators are customarily individual private residents. Standards and regulations are relative to the state in which the technology is used. The state of Georgia currently does not provide design standards for on-site sand filter systems, necessitating residents to employ costly proprietary sand filter systems.

With a set of design standards approved by the Georgia Land Use Division, certified installers could design and build more inexpensive on-site sand filter systems for private use. To aid in the development of such standards, LDP Engineering has designed, constructed, and hydraulically tested a bench-scale sand filter system capable of loading three different filter media. The system will be a vehicle for future student research to evaluate fine, coarse, and median variations of ASTM C33 sand, an aggregate of interest to the Land Use Division. Existing design standards from the states of North Carolina, Oregon, and Washington and the United States Environmental Protection Agency were consulted. Hydraulic testing of the system was governed by National Sanitation Foundation recommendations. The final design was constructed in the Mercer University Environmental Engineering Laboratory. Gravity powers flow through the key components of the system, including a storage and dosing structure, septic tank, flow splitter, and three media-filled columns with effluent structures. Hydraulic testing of an initial septic-to-flow-splitter structure proved the design’s ability to evenly divide dose volumes between the three filters. This structure also successfully resisted overflow when the maximum possible test flow to the system was imitated. An operations and maintenance manual accompanies the constructed system. This document will aid future student efforts by providing instructions for sampling, loading and testing of the influents and effluents. Detailed design information will ensure ease of system upkeep, increasing the sustainability and constructive productivity of the project.

Testing of ASTM C33 as a domestic wastewater sand filter media must ensure its suitability for use in Georgia’s residential systems before it can be recommended in future Georgia design standards. The established bench-scale system resulting from this design project is a reliable medium for future student research, providing verified ASTM C33 performance evaluation data and recommendations to the Land Use Division of Georgia.

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Embry-Riddle Unmanned Search and Rescue System

Savannah L Kirby\textsuperscript{6} and Noah J Potash\textsuperscript{7}

Abstract - The Search and Rescue (SAR) system is a coordinated air and ground multi-robot search team designed to alleviate the workload placed upon rescue teams by providing an automated tool for target identification and surveillance. Unmanned air and ground vehicles work together to supply advanced search capabilities in lieu or in support of deployed first responders.

Team Structure

The project is divided into three main teams of computer and software engineering students organized by experience, skills, and individual preference – Unmanned Aerial Vehicle (UAV), Unmanned Ground Vehicle (UGV), and Ground Control Station (GCS). The GCS is divided into four sub-teams, each responsible for a subsystem – Waypoint Management, Communication, User Interface, and Image Processing. Tasks are managed using the Crystal Clear agile process.

Design Summary

The UAV team is responsible for the design and development of a four-rotor helicopter (quad-copter). The vehicle must transmit a live video feed while navigating under autonomous or manual radio control (RC). Main tasks include the design and implementation of hardware, software, and stability control algorithms, as well as communication with the GCS.

The UGV team is tasked with the modification of a Power Wheels™ vehicle into a computer-controlled robot. The UGV must be able to drive autonomously or by RC and convey live video, targeted thermal readings, and bidirectional audio to allow an operator to communicate with victims. Tasks include hardware modification, algorithm creation, and GCS communication.

Each UAV autonomously flies to GCS supplied waypoints while providing visuals to the image processing system which uses basic blob analysis techniques to extract potential human targets from captured images. The waypoint management system distributes these points of interest to the UGVs which use multiple sensors to autonomously navigate to the supplied locations for closer investigation. GCS operators verify the vehicle’s findings, and take appropriate action.

Results Summary

By leveraging the stability of a quad-copter and the maneuverability of a small rugged ground vehicle, it is both feasible and practical to use autonomous systems to expedite rescue times, expand search areas, and decrease risks for rescue workers. The low cost and easy deployment of the system makes it an attractive tool in the arsenal of an emergency response team.

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Microbial Fuel Cell Wastewater Treatment for Developing Nations

Jamie Joyner and Leah Moore

Abstract - Everyday, people in developing nations around the world suffer from illnesses related to contaminated drinking water sources. The lack of available clean drinking water in these communities can be attributed to many varying factors. Two such factors that plague developing nations are scarce natural water resources and the absence of sanitary waste disposal and treatment systems. Most developing nations utilize nearby rivers as their water source while using the same rivers for waste disposal. This continuing cycle threatens the lives of thousands of people every day.

The project’s goal was to design, build and test bench-scale models of a microbial fuel cell (MFC). A MFC is a device that utilizes biological processes to generate electrical energy while simultaneously removing pollutants from the feed source. In this project, the bacteria in the cell were responsible for creating electrical energy and removing pollutants from influent wastewater. The MFC was designed to function in a developing nation’s rural population and, therefore, the system was constructed with sustainability in mind, utilizing inexpensive, readily available materials. Testing of the cells would hopefully reveal to what extent MFCs can treat human wastewater. Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), pH, and total solids levels were monitored before and after MFC treatment. A correlation between the cell efficiencies and resulting electrical output was also determined.

Microbial fuel cells utilize an anode-cathode exchange system to operate. The design that was developed consisted of a cubic anode chamber with a cylindrical cathode centered within it. Large panels of carbon cloth served as the anodes in the anaerobic chamber where the wastewater was contained. A copper wire circuit and resistor connected the anode panels to a graphite rod resting in deionized water in the aerobic cathode chamber. Multiple bench-scale microbial fuel cells were operated to determine the efficiency of various cathode chamber materials including geotextile-wrapped well screen piping and several HDPE (high-density polyethylene) pipes with different porosities.

Testing indicated that the bacteria within the MFCs required approximately 72-80 hours to become acclimated. Numerous water quality tests proved the MFCs to be very capable of reducing BOD, COD and solids levels to the desired concentrations chosen by the team and their client. Porous HDPE cathode chambers tended to keep the anode chamber anaerobic and the cathode chamber aerobic more efficiently than the socked slotted well screens. Electrical outputs were small but generally very consistent, which can be a good sign for future microbial fuel cell developments.

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Probabilistic Location of a Populated Chessboard Using Computer Vision

Jason E. Neufeld\textsuperscript{10} and Tyson S. Hall\textsuperscript{11}

Abstract - Development of autonomic chess-playing robots creates several interesting computer vision problems, including plane calibration and object recognition. Various solutions have been attempted, but most either require a modified chess set or make unreasonable constraints on board conditions and camera angles. A more general solution uses computer vision to automatically determine arbitrary chessboard location and identify chessmen on a standard, unmodified chess set. This project presents a novel solution to the board location problem that is accurate, less restrictive, and relatively time efficient.

Implementation and Optimizations

After evaluating multiple existing algorithms, the “highest probabilistic match” method was developed to be more efficient and robust than current methods. The highest probabilistic match method heuristically finds groups of four potential board corners and compares the resulting image data within the formed quadrilateral to an ideal chessboard. A Hough transform is used to locate lines in the image, and quadrilaterals are constructed through the intersections of two horizontal and two vertical lines, with one intersection in each quadrant of the screen. Since chessboard squares alternate between light and dark colors, the mean intensity of each potential square versus absolute high and low values is used to determine the probability that the quadrilateral is a chessboard.

The algorithm checks each quadrilateral, so time complexity is $O(n^3)$. The amount of tests must be reduced through realistic constraints to achieve reasonable performance. If the board is assumed to be at a viewing angle similar to that of a typical human player, the image can be separated into quadrants, and each potential intersection is tested only against neighboring quadrants. Also, Hough transform settings have been adjusted to ensure that strong lines of the board edges are detected while reducing weaker lines due to chessmen and other image noise.

Testing and Results

The board location algorithm was verified using several test images of a standard tournament chessboard with various piece setups. Tested metrics were the accuracy of final board location and running time of the algorithm.

Test results were positive, with the proposed system detecting the correct board location on all test images. Mean location time on test images was 780 milliseconds. This algorithm can be integrated into a system with piece recognition and a robotic arm to provide a fully interactive autonomic chess experience.

*Faculty Advisor

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Time Domain Reflectometry and Water Level Measurement in Porous Media

Jessica L. Pippard

Abstract - Time domain reflectometry (TDR) is a measurement technique that makes use of the time it takes for an electrical impulse to reflect back to a source. The reflected signal (waveform) may be correlated to a variety of soil properties, including moisture content and conductivity. This project studied the potential for the application of TDR technology to the measurement of landfill leachate levels. There are a number of factors that could impact the use of TDR for leachate level measurement, including the media surrounding the probe, the conductivity of the liquid, and the probe configuration. This project evaluated the impact of the size of the media surrounding the TDR probe. The TDR probe used in this study consisted of a 30.5-cm long, 5.08-cm diameter PVC well screen with 0.51-cm slots surrounded by a stainless steel mesh with a stainless steel rod running through the center. The outer stainless steel mesh was soldered to the outer braid (shield) of a co-axial cable while the center rod was soldered to the conductor of the co-axial cable. The TDR measurement was taken via a Campbell Scientific TDR 100.

Experiments were conducted by placing the probe in a large cylinder with tubes attached for draining of the cylinder and reading of the water level within the cylinder. The cylinder was filled with water at ~2cm intervals to a depth of 25cm and then completely drained at intervals of ~2cm. TDR waveforms were taken for each water level. The data was then manipulated to identify the correlation between the waveforms and the water depths. These experiments were conducted with the probe standing in open water and then surrounded by small, medium, and large gravel.

The evaluation of the data consisted of identifying a distinct change in the TDR waveform which could be correlated to the air-water interface. This point on the TDR waveform was then plotted against the water depth in the column. The relationship was found to be linear with a correlation coefficient of 0.9935 for the experiment with only water, 0.9854 for the small rock media, 0.9973 for the medium rock media, and 0.9967 for the large rock media. These results indicated that the TDR waveforms can be used to accurately measure water depth in a variety of porous mediums. The next phase of this project will be to evaluate the impact of liquid conductivity on the waveform measurement.

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Computational Micromechanics: Effective Electrical Conductivity of Carbon Nanotube-Polymer Nanocomposites

Anne-Sophie Puydupin-Jamin\textsuperscript{13} and Gary Seidel\textsuperscript{14}

Abstract - Nanocomposite development in the aerospace industry has been encouraged due to their considerable structural enhancements, particularly for material composed of carbon nanotubes included in a polymer matrix. In an effort to explore the nanocomposites’ material properties, previous works have made use of a computational micromechanics model for the analysis of the effective electrical conductivity for well dispersed configurations and a few clustered configurations. In the present work, the clustering impact is studied in detail using configurations with a varying degree of bundle packing. This study also completes previous works by examining the effect of interphase thickness, interphase conductivity and a detailed analysis of the percolation region as a function of the interphase layer thickness.

In the present study, a multiscale model has been developed to analyze the nanocomposite electrical enhancements using a computational micromechanics analysis. Periodic arrangements of well dispersed and bundled nanotubes have been studied using the commercially available finite element software COMSOL v3.4. The computation of the effective electrical conductivity is completed for two different SWCNT (Single Walled Carbon Nanotube) representations, one where they have their actual hollow shape and one where the nanotubes are approximated by a solid shape. The properties of the nanotubes depend on whether the hollow or the solid representation is used since the hollow has an isotropic behavior while the solid is transversely isentropic. However, the same periodic conditions are applied to both Representative Volume Elements (RVEs) with solid nanotubes and RVEs with hollow nanotubes, and the results are compared to assess the quality of the solid approximation. A transversal change in electric potential is applied across the RVE to obtain the effective electrical conductivity of the nanocomposite and the volume averaged electric field and the temperature gradient are obtained. From the results, it appears that effective and hollow representations yield nearly identical results for low SWCNT volume fractions among the RVE.

The influence of the presence of an interphase region on the effective transverse conductivities is considered in a parametric study in terms of both interphase thickness and conductivity. The effect of clustering is investigated using RVEs with four different degrees of bundle packing. Finally, the results of each of the clustered arrangements are compared to the well dispersed with and without interphase results, and the percent difference relative to the well dispersed case is calculated. The resulting metric indicates that when comparing the impact of clustering and the effect of adding an interphase region, clustering has less impact than the addition of an interphase region on the effective electrical transverse conductivity of the nanocomposite.

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Flow Calorimeter: A Thermodynamic Demonstration

Lauren E. Word\textsuperscript{15} and Emory Hannah\textsuperscript{16}

Abstract - The purpose of the team design project was to design a classroom DEMO which demonstrates a thermodynamic concept. The intended use of the project was such that the project would be a contained “desktop” module to be used in classroom activities.

Team Structure

The four team members were selected by Dr. Donald Visco, the supervising teacher involved in the project. The team selected Lauren Word as the team leader by appointment and vote. The team leader was responsible for organization of meetings and group communication. A safety advisor, Emory Hannah, was also elected by vote and was responsible for exploring and defining the safety concerns associated with the project. Philip Schmidt lead efforts in the theory and calculations related to the concept demonstrated and their integration into the project. Chad Kimsey was the primary materials and construction researcher and reference.

Design

Heat capacity was chosen as the thermodynamic principle to be demonstrated. By providing a visualization of the process and variables related to heat capacity determination, it was hoped that students would be better able to contextualize a somewhat abstract thermodynamic quantity. Many types of calorimeters were researched and evaluated as possible design options. Primary considerations in the design of the calorimeter were safety, cost, ease of operation, and effectiveness as a thermodynamic learning tool. A flow calorimeter was the design concept chosen because of its ease of use, relatively safe operating conditions, and adaptability to student demonstration.

Cost control and “desktop” size were the most difficult aspects of the design to incorporate concurrently and required some design rework and tradeoff. The design materials selected were evaluated for appropriateness and safety, especially those exposed to heat or pressure. During construction, system modifications were required to effectively mesh the system components and ensure the integrity of the module measurements. The final classroom friendly design used battery powered components and took up no more space than provided by a quad of desks.

Results

The constant pressure specific heat of water was measured using the device in test runs and in a classroom demonstration. The average constant pressure heat capacity of tap water calculated from four module readings was 4.55 ± .33 J/g*C. The literature value\textsuperscript{1} 4.186 J/g*C deviated from the average reading by 8.69 percent. These measurements erred slightly above the literature value and the error tended to increase as the battery life decreased. This error trend occurred due to a gradual but increasing rate of power loss in the pump and heating element during readings as the battery power was consumed.

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The Effect of Sample Storage Time and Temperature on Oxygen Uptake Rate Measurement

Andrew Simms\textsuperscript{17} and Kristen Wyckoff\textsuperscript{18}

Abstract - The typical method of preserving samples for oxygen uptake rate (OUR) analysis includes a bottle that was completely filled with a water sample sealed with a piece of aluminum foil and a rubber band. Samples are not usually stored in order to take measurements at later times. The OUR is typically measured on site because it is believed that waiting will affect the oxygen values in the water.

The purpose of this experiment was to determine the affects of storage time and temperature on the oxygen uptake rate measured in wastewater samples taken from the outflow of the aeration basin at the Lower Poplar Street Municipal Wastewater Treatment Plant in Macon, Georgia. Two sample storage protocols were used, storage at room temperature, approximately 22° C, or refrigerated storage, approximately 10° C. Measurements were taken once each week using two of each sample type for a total of seven weeks. The dissolved oxygen concentration was measured at thirty second intervals over ten minute time period for each sample in order to determine the rate of oxygen consumption [(mg/L)/min]. Before any measurements were taken, the samples were removed from storage. The refrigerated samples were allowed to sit out and increase in temperature. The samples were all prepared separately from one another. Each sample was shaken so that all of the organic content in the bottle was uniform throughout and was poured into a 1000 mL graduated cylinder. Then thirty milliliters of de-ionized water was poured into the BOD bottle to remove any excess water, which was then added to the graduated cylinder. Then the sides of the graduated cylinder were rinsed off using de-ionized water until the water reached 350 mL. The water was then swirled to keep the mixture consistent throughout the entire solution and poured into a 600 mL beaker. A pump was connected to the beakers and the samples were each aerated for fifteen minutes, raising the oxygen concentration. Then the sample was placed back into the original BOD bottle which now contained a magnetic stirrer. The calibrated DO meter was inserted into the BOD bottle and placed on top of a magnetic stirrer and measured for the entire ten minute interval once the dissolved oxygen value had stabilized.

The average OUR for the two samples vary slightly from one another. The room temperature sample change ranged from 1.46 mg/L/min to 2.95 mg/L/min with an average drop of 2.218 mg/L/min. The cold samples had a change that ranged from 1.83 mg/L/min to 4.03 mg/L/min with an average change of 2.813 mg/L/min. In conclusion, the oxygen uptake rate for the refrigerated samples showed a larger difference between the initial and final readings. Through observations of the color of the settled sludge, it was determined that the chemical processes that controlled the deterioration of the organic content was slowed considerably by refrigeration.

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Detection of Trace Explosives by Photothermal Deflection Spectroscopy

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Abstract - When a beam of electromagnetic radiation passes through a substance, it is absorbed or transmitted, depending upon its frequency and the structure of any molecules it encounters. A substance can be characterized by how radiation interacts with it: absorption spectroscopy, for example, characterizes a material’s tendency to absorb or attenuate particular wavelengths of radiation. Similarly, photothermal spectroscopy uses a scanning monochromator to determine the spectral absorption of a small number of molecules absorbed onto the surface of a thermal detector. In this study we used commercially available silicon microcantilever with dimensions of 290 $\mu$m length, 40 $\mu$m width, and 1 $\mu$m thickness for spectral detection of three explosives -- trinitrotoluene, cyclotrimethylene trinitramine and pentaerythritol tetranitrate. The silicon microcantilever was coated with 10 nm of Chromium as an adhesion layer, then with 100 nm of gold. The explosives were deposited directly on the bimaterial cantilever with a micropipette and the solvent was allowed to evaporate. As the explosive condenses on the cantilever, the cantilever bends and the resonance frequency varies. The resonance frequency of the cantilever was measured after exposure to the explosive sample to determine mass loading by explosive molecules. The spectral detection of the molecules results when the adsorbate on the cantilever is irradiated with monochromatic infrared light. A thermo-mechanical deflection was produced when the light coming from the IR source impacts the cantilever tip, causing it to bend. The bending of the cantilever beam was monitored using an optical beam deflection arrangement and a Position Sensitive Detector (PSD); the PSD’s output voltage is directly proportional to the cantilever’s deflection. After the resonance frequency was measured, the monochromator (with its IR light focused via a concave mirror on the cantilever) scans between 2.5 and 14.5 $\mu$m wavelengths, while the lock-in amplifier records the cantilever’s bending and generates an IR profile of the explosive-laden cantilever. Asymmetric and symmetry stretch usually appears in the range of 6.0-6.8 and 7.0-8.0 $\mu$m, respectively, and these vibrational bands are intense and readily identified. We demonstrated that by combining photothermal deflection spectroscopy and resonance frequency shift, we can obtain very high selectivity for detecting trace levels of explosive, while maintain sensitivity.

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Chapter 4  Index
<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
<th>Paper</th>
<th>Presentation</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aarons</td>
<td>Tyler</td>
<td>Implementing a Peer Leadership Model in a Large Scale Peer Mentoring Program</td>
<td>T3-B: Administrative Division No. 2 Time: 3:40pm - 5:20pm Room: Smithfield</td>
<td>Chapter 2 - 44</td>
</tr>
<tr>
<td>Abukmail</td>
<td>Ahmed</td>
<td>Towards the Development of Programming Skills for First-Time-Programmers</td>
<td>T4-C: Computer engineering/Graphics Time: 8:30am - 10:10am Room: Drillfield</td>
<td>Chapter 2 - 66</td>
</tr>
<tr>
<td>Adenariwo</td>
<td>Adeyemi A.</td>
<td>Implementation and Evaluation of Laboratory/Tutorial Exercises for Software Defined Radio Education</td>
<td>T2-D: Electrical/Industrial Division No. 1 Time: 1:40pm - 3:20pm Room: Drillfield</td>
<td>Chapter 2 - 34</td>
</tr>
<tr>
<td>Ahn</td>
<td>Yong Han</td>
<td>Greening the Educational Experience: Strategic Entry Points for Sustainability in the Existing Curricula</td>
<td>T5-B: Professional Skills Division No. 2 Time: 10:20am - 12noon Room: Solitude</td>
<td>Chapter 2 - 80</td>
</tr>
<tr>
<td>Allevato</td>
<td>Anthony</td>
<td>Discovering Patterns in Student Activity on Programming Assignments</td>
<td>T2-B: Instructional Division No. 2 Time: 1:40pm - 3:20pm Room: Solitude</td>
<td>Chapter 2 - 25</td>
</tr>
<tr>
<td>Altan</td>
<td>Taylan</td>
<td>Whatever Happened to Product Realization? Will Technology Programs Succeed Where Engineering Programs Have Failed?</td>
<td>T2-A: Mechanical Engineering Division No. 1 Time: 1:40pm - 3:20pm Room: Smithfield</td>
<td>Chapter 2 - 21</td>
</tr>
<tr>
<td>Aly</td>
<td>Zulfiqar</td>
<td>Updating an old course: What does it take?</td>
<td>T4-D: Instructional Division No. 4 Time: 8:30am - 10:10am Room: Solitude</td>
<td>Chapter 2 - 73</td>
</tr>
<tr>
<td>Anderson</td>
<td>Robin D.</td>
<td>Measuring Achievement Goal Orientations of Freshman Engineering Students</td>
<td>T3-D: Research Division No. 1 Time: 3:40pm - 5:20pm Room: Drillfield</td>
<td>Chapter 2 - 52</td>
</tr>
<tr>
<td>Ansley</td>
<td>Marcus H.</td>
<td>Capstone Courses: Why They Work and Why They Don’t</td>
<td>T4-A: Civil Engineering Division No. 2 Time: 8:30am - 10:10am Room: Duck Pond</td>
<td>Chapter 2 - 59</td>
</tr>
<tr>
<td>Artigue</td>
<td>Aaron</td>
<td>Achieve objectives of engineering design course through the jansen project and a design sample</td>
<td>T5-D: Mechanical Engineering Division No. 2 Time: 10:20am - 12noon Room: Duck Pond</td>
<td>Chapter 2 - 89</td>
</tr>
<tr>
<td>Artis</td>
<td>Sharnnia</td>
<td>Student Success – Oriented Needs Analysis: A Conceptual Framework</td>
<td>T3-D: Research Division No. 1 Time: 3:40pm - 5:20pm Room: Drillfield</td>
<td>Chapter 2 - 55</td>
</tr>
<tr>
<td>Last Name</td>
<td>First Name</td>
<td>Paper</td>
<td>Presentation</td>
<td>Page</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Augsburger</td>
<td>Kathryn</td>
<td>Undergraduate Civil Engineering Sustainability Education Metric</td>
<td>T1-B: Civil Engineering Division No. 1 Time: 10:20am - 12 noon Room: Drillfield</td>
<td>Chapter 2 - 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(UCESEM): Benchmarking Civil Engineering Program Performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aziz</td>
<td>Mena</td>
<td>From the Classroom to the Operating Room: Cutting Edge and the Student</td>
<td>T5-E: Administrative Division No. 3 Time: 10:20am - 12 noon Room: Cascade A</td>
<td>Chapter 2 - 94</td>
</tr>
<tr>
<td>Back</td>
<td>Godmar</td>
<td>An Infrastructure for Teaching CS1 in the Cloud</td>
<td>T5-A: Software Engineering Division No. 1 Time: 10:20am - 12 noon Room: Smithfield</td>
<td>Chapter 2 - 77</td>
</tr>
<tr>
<td>Bailey</td>
<td>Margaret B.</td>
<td>Self-efficacy in female and male undergraduate engineering students: Comparisons among four institutions</td>
<td>T3-B: Administrative Division No. 2 Time: 3:40pm - 5:20pm Room: Smithfield</td>
<td>Chapter 2 - 42</td>
</tr>
<tr>
<td>Ball</td>
<td>Aaron</td>
<td>A case study: an energy audit for a small municipality in North Carolina</td>
<td>T1-D: Professional Skills Time: 10:20am - 12 noon Room: Duck Pond</td>
<td>Chapter 2 - 16</td>
</tr>
<tr>
<td>Ball</td>
<td>Aaron K.</td>
<td>A Low Cost Conveyor System for Teaching Automation to Engineering Technology Students</td>
<td>T3-A: Engineering Technology Division No. 1 Time: 3:40pm - 5:20pm Room: Duck Pond</td>
<td>Chapter 2 - 36</td>
</tr>
<tr>
<td>Ball</td>
<td>Aaron K.</td>
<td>Industry Partnerships at Western Carolina University: Live Projects that Work</td>
<td>T3-A: Engineering Technology Division No. 1 Time: 3:40pm - 5:20pm Room: Duck Pond</td>
<td>Chapter 2 - 39</td>
</tr>
<tr>
<td>Banning</td>
<td>Thomas E.</td>
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<td>T4-B: K12 Outreach Division No. 2 Time: 8:30am - 10:10am Room: Smithfield</td>
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<td>Blended Instruction in an Introductory Engineering Graphics Course: Understanding How Students Utilize Online Instructional Resources</td>
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<td>Presentation</td>
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<td>Freshman Engineering Student Perceptions of Engineering Disciplines</td>
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<td>Presentation</td>
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Chapter 2 - 26
Chapter 2 - 63
Chapter 2 - 23
Chapter 2 - 44
Chapter 2 - 3
Chapter 2 - 22
Chapter 2 - 44
Chapter 2 - 43
Chapter 2 - 33
Chapter 2 - 34
Chapter 2 - 34
<table>
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<td>Transportation – Learning on the Move</td>
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<td>Faculty Student Advising at Western Carolina University</td>
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<td>T3-B: Administrative Division No. 2 Time: 3:40pm - 5:20pm Room: Smithfield</td>
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<td>Synergistic Learning &amp; Inquiry through Characterizing the Environment for Sustainability (SLICES): Improving Understanding of Real World Systems through Observation &amp; Reflection</td>
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<td>T3-D: Research Division No.</td>
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<td>Directions for Engineering and Technology Educators to Improve Program Enrollments</td>
<td>T1-C: Administrative Division No. 1 Time: 10:20am - 12 noon Room: Smithfield</td>
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<td>Measuring Achievement Goal Orientations of Freshman Engineering Students</td>
<td>T3-D: Research Division No. 1 Time: 3:40pm - 5:20pm Room: Drillfield</td>
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<td>Student Success – Oriented Needs Analysis: A Conceptual Framework</td>
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<td>Godoy</td>
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<td>Interviews with Experts in which they Explain how they Solved Structural Failure Investigations</td>
<td>T1-B: Civil Engineering Division No.1 Time: 10:20am - 12 noon Room: Drillfield</td>
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<td>Chapter 2 - 19</td>
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<td>T2-A: Mechanical Engineering Division No. 1 Time: 1:40pm - 3:20pm Room: Smithfield</td>
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<td>Last Name</td>
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<td>Presentation</td>
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<td>Chapter 2 - 68</td>
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<td>Chapter 2 - 26</td>
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4-14
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<td>Introducing High School Girls To PC Board Assembly</td>
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<td>The Effect Knowledge Dissemination Structures Play in Increasing Design Efficiency in Small Design Teams</td>
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<td>Chapter 2 - 92</td>
</tr>
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<td>First Name</td>
<td>Paper</td>
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<td>T3-D: Research Division No. 1 Time: 3:40pm - 5:20pm Room: Drillfield</td>
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<td>Self-efficacy in female and male undergraduate engineering students: Comparisons among four institutions</td>
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<td>Capstone Courses: Why They Work and Why They Don’t</td>
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<td>A Pre-Engineering Class to Help Transition Students Into an Engineering Major</td>
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<td>Interdisciplinary and experiential approach towards the teaching of materials science and engineering</td>
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<td>Blended Instruction in an Introductory Engineering</td>
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<td>From the Classroom to the Operating Room: Cutting Edge and the Student</td>
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<td>Introducing Undergraduates to Load Calculations: A Course Designed Around ASCE-7</td>
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<td>Whatever Happened to Product Realization? Will Technology Programs Succeed Where Engineering Programs Have Failed?</td>
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<td>Yanik</td>
<td>Paul</td>
<td>Directions for Engineering and Technology Educators to Improve Program Enrollments</td>
<td>T1-C: Administrative Division No. 1 Time: 10:20am - 12noon Room: Smithfield</td>
<td>Chapter 2 - 10</td>
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<td>Yousif</td>
<td>Nabil</td>
<td>Factors Affecting the Performance of Students in a Data Structures Course at Fort</td>
<td>T5-A: Software Engineering Division No. 1 Time: 10:20am - 12noon Room: Smithfield</td>
<td>Chapter 2 - 79</td>
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<td>Last Name</td>
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| Zhou      | Zhaoxian   | LabVIEW-based Laboratory for Electronics Engineering Technology Program | T3-A: Engineering Technology Division No. 1  
Time: 3:40pm - 5:20pm  
Room: Duck Pond | Chapter 2 - 37 |
| Zhou      | Zhaoxian   | Practice of Increasing Enrollment and Retention of Electronics Engineering Technology Program | T3-A: Engineering Technology Division No. 1  
Time: 3:40pm - 5:20pm  
Room: Duck Pond | Chapter 2 - 38 |